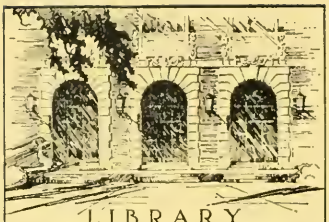

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The Prairie Province of Illinois

A Study of Human Adjustment
to the Natural Environment

By

Editii Muriel Poggi

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PREFACE

This study represents an attempt to discern the character and influence of the various elements of the natural environment—topography, soil, climate, vegetation, mineral resources, and location—upon the settlement and development of the prairie province of east-central Illinois, and to determine the extent of man's adjustment to these environmental conditions. Following the introductory chapter on the geographic regions of Illinois, the first part of the study consists of five chapters on the physical setting of the prairie province; the second part deals with agriculture and mineral industries as major human adjustments; and the third part is an interpretation of the geographic and economic conditions influencing settlement and development. The work is based upon a personal knowledge of the region, gained through five years of residence and through field trips. The writer received much valuable help from many experts in their fields, especially members of the State Geological Survey, particularly Dr. George E. Ekblaw, and members of the Agricultural Experiment Station and the Departments of Agronomy and Agricultural Economics in the University of Illinois, particularly Dr. R. S. Smith and Mr. C. M. Linsley. Dr. O. E. Baker, of the U. S. Department of Agriculture, gave helpful suggestions and criticisms of the section on land utilization, as did also Mr. C. C. Burns, Champaign County Farm Adviser, of the section on livestock. To Professor W. O. Blanchard, of the Department of Geology and Geography in the University of Illinois, special thanks are due for his criticism and generous help.

HARDAWAY

CONTENTS

I. The Geographic Regions of Illinois 11

II. Glaciation and Its Influence upon Topography . . 22

III. Surface Water and Ground Water 35

IV. Soils 48

V. Climatic Elements in Relation to Corn Production 57

VI. Natural Vegetation 65

VII. Agriculture 71

VIII. Mineral Industries 89

IX. Settlement and Development 97

Bibliography 118

Index. 121

ILLUSTRATIONS

Relief map of Illinois, showing boundary of the prairie province . . . . . (*Frontispiece*)

1. Map of North America showing maximum extent of ice sheets 13
2. Map of Illinois showing glaciation 14
3. Map of Illinois showing physiographic regions 16
4. Maps of Illinois showing annual rainfall and length of growing season. . . 17
5. Map of Illinois showing natural vegetation 18
6. Map of Illinois showing geographic regions 20
7. Map of northeastern Illinois showing glacial geology. 23
8. Map of Illinois showing percentage of hilly land in each county 38
9. Graphs showing erosion of soil and runoff of rainfall 39
10. Map of Champaign County showing sources of streams 41
11. Topographic map of an area near Paxton, Illinois 42
12. Graphs showing artificial drainage in the prairie province 43
13. Map of Illinois showing artificial drainage in each county in 1919 44
14. Map of Illinois showing locations of drift wells for public water supplies . . 46
15. Diagrams of profiles of soils in Illinois 50
16. Map of the United States showing major soil divisions 52
17. Map of northern and central Illinois showing soil types 53
18. Graphs showing average temperature and rainfall in the prairie province . 58
19. Graphs showing correlation of July rainfall and corn yields in Illinois . . 60
20. Map of Illinois showing average annual snowfall 62
21. Map of the United States showing distribution of native grasses 66
22. Map of the United States showing ratio of rainfall to evaporation . . . 68
23. Graphs showing acreage and value of crops in the prairie province in 1925 . 74
24. Map of Illinois showing corn acreage in 1925 75
25. Map of Illinois showing swine distribution in 1925 75
26. Map of Illinois showing hay acreage in 1925 75
27. Map of Illinois showing wheat acreage in 1925 75
28. Map of Illinois showing oats acreage in 1925 75
29. Graphs showing labor required by crops in Illinois 76
30. Graphs showing relative food values of twelve farm products 82
31. Map of Illinois showing coal production by counties in 1926 90
32. Airplane view of strip-mine operations near Danville, Illinois 93
33. View of steam shovels loading coal near Danville, Illinois 94
34. Map of Illinois showing distribution of clay products plants in 1927 . . . 95
35. Maps of Illinois showing population density by decades from 1800 to 1910 . 102
36. Maps of Illinois showing decrease in rural population from 1900 to 1920 . . 107
37. Map of Illinois showing density of population in 1930 108
38. Map of the prairie province showing distribution of population in 1930 . . 110
39. Maps of Illinois showing land values and farm tenancy in 1925 111
40. Map of Illinois showing railroads in 1855 112
41. Map of Illinois showing railroads in 1930 113
42. Map of Illinois showing highways in 1832 114
43. Map of Illinois showing state highways in 1930 115

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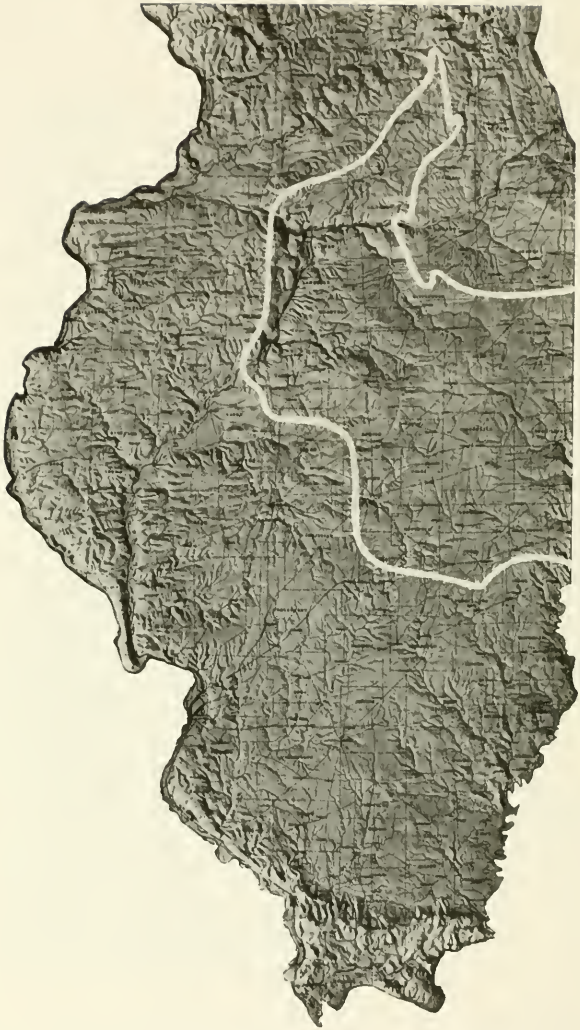

Relief Map of Illinois, Showing Boundary of the Prairie Province
(Courtesy of Illinois Geological Survey.)

CHAPTER I

THE GEOGRAPHIC REGIONS OF ILLINOIS

Since it is the function of the geographer to determine the significance of the physical environment to man, it is necessary to divide the earth into homogeneous regions throughout each of which the dominant human responses are in close adjustment to the dominant environmental conditions. In doing this the geographer may be aided by the physiographer, the climatologist, the ecologist, and the ethnologist; but their divisions, separately or together, do not completely serve his purpose. A geographic region is one that is set off from adjacent regions by the sum of its physical characteristics, and within such a region the dominant physical conditions result in a similarity of economic possibilities. In one geographic region the topography may exert the most significant influence on man's activities; in another it may be the native vegetation, the climate, or important mineral deposits. So the emphasis is shifted to the most significant factors in each region, and geographic boundaries are determined by the reflection of the natural environment in the activities of the people. In Illinois the physiographic regions, which here constitute the primary basis for determining geographic regions, are largely the result of the advance and recession of the great ice sheets of the Glacial Epoch. For this reason the following study begins with a description of the state in terms of its recent geologic history.

Illinois forms part of the Great Central Plain of the United States. It has the lowest mean elevation of the North Central States, its average height being estimated at 600 feet above sea level, while that of Indiana is 700, Michigan 900, and Wisconsin 1,050 feet. Only two other states in the Union have a more level surface, namely, Delaware and Louisiana. The lack of relief in Illinois is evidenced by the fact that the highest point, Charles Mound (in Jo Daviess County), is 1,241 feet above sea level, while the lowest point, at the junction of the Ohio and Mississippi, is 268 feet; that is, the total relief in 400 miles is less than 1,000 feet.

The uniform topography is largely due to the fact that nine-tenths of the state was covered by one or more of the ice sheets of the Pleistocene Period. The work of the ice was primarily that of deposition: its effect was to spread rock waste over the area, to fill the valleys, and to wear off topographic prominences, thus obliterating the pre-glacial features. On the whole, the surface left on the retreat of the last ice sheet was that of a gently undulating plain. At or near the margins of the drift

sheets and along lines where the ice halted, or to which it re-advanced after retreat, the drift was concentrated in morainic ridges.[1]

Geologists recognize the following divisions of the Pleistocene Period, or Glacial Epoch, in North America:

1. Wisconsin Glacial Stage.
   Peorian Interglacial Stage.
2. Iowan Glacial Stage.—(The ice sheet of this period is now considered not to have entered Illinois.)
3. Illinoian Glacial Stage.
   Yarmouth Interglacial Stage.
4. Kansan Glacial Stage.
   Aftonian Interglacial Stage.
5. Nebraskan Glacial Stage.

According to recent studies of the State Geological Survey, Illinois embraces seven physiographic regions, which may be considered in three groups as follows: (a) the unglaciated areas, (b) the areas of old glacial till, and (c) the areas of more recent glacial till.

Unglaciated Areas

The entire state was not glaciated. The ice advanced over the east and central part of the continent from two main centers of dispersion; these were the district of Keewatin, west of Hudson Bay, and the interior of the Labrador Peninsula (Fig. 1). The earliest and most extensive sheets advanced as far south as the Illinois Ozarks, where these hills seem to have held up its progress, and there is no decisive evidence of glacial activity to be found on the south side of this uplift.

One of the most interesting evidences of the independent movement of the different portions of the continental ice sheet from these two centers is to be found in the driftless area, of approximately 15,000 square miles, which lies in southwestern Wisconsin and extends into the northwest corner of Illinois and the adjacent part of Iowa. This area was not glaciated because it was in the lee of the elevated territory of northern Wisconsin and Michigan, which acted as a wedge forcing the ice away and causing it to deploy on either side.[2] The glacial lobes, however, closed together on the south and continued to advance. The second driftless area, as previously noted, is in the extreme southern part of the state and includes the Ozark Uplift. In both these areas the topography, which is comparatively rough, forms a striking contrast to the flat or gently undulating surface in the glaciated parts of the state.

[1] Leverett, Frank, *The Illinois Glacial Lobe*, p. 102.
[2] Bowman, Isaiah, *Forest Physiography*, p. 496.

Areas of Old Glacial Till

The advances and recessions of the ice front during the several stages listed above resulted in deposits of till of varying thickness, with weathered drift zones and loess deposits alternating with these. The Nebraskan drift is found beneath the Kansan and Illinoian, and the Kansan underlies the Illinoian in the west of the state. It is now known that Calhoun

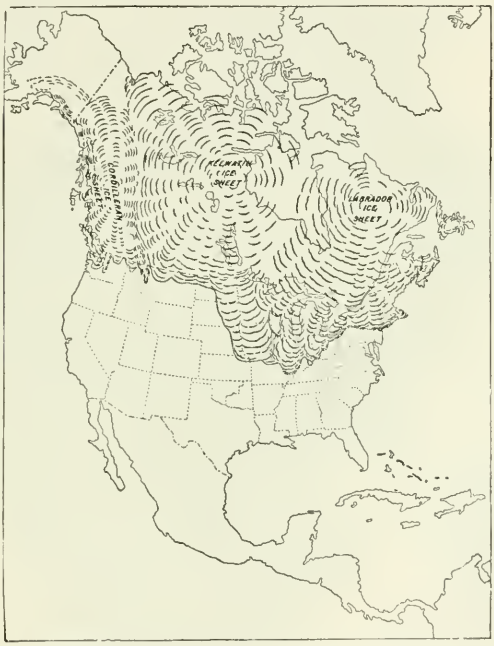

Fig. 1.—Map of North America showing the maximum extent of the ice sheets of the Glacial Period. (Courtesy of Illinois Geological Survey.)

County, which was for long considered a driftless area, was glaciated during the Kansas stage. The Illinoian drift sheet is the most extensive in the state; the ice advanced to 37° 30′ N. Lat., which is the most southerly point covered by glaciation in North America. Both the Illi-

FIG. 2.—Map of Illinois showing glaciation (after Leverett). (Courtesy of Illinois Natural History Survey.)

noian and Wisconsin ice sheets appear to have advanced from the Labrador center of dispersion, while the Kansan originated in the Keewatin center.

Starting from two widely separated points and advancing over different rock surfaces, these sheets deposited till which naturally is variable in composition. There are other marked differences between the more recent Wisconsin drift and the older Illinoian drift: the drainage of the Illinoian is mature, in marked contrast to that of the Wisconsin area with its many marshes and diverted streams; also the bowlders and pebbles of the older drift are much more weathered than in the new, so that even some granite pebbles can be crumbled in the hand.

Areas of More Recent Glacial Till

The areas of most recent drift lie in the northeast quadrant of the state (Fig. 2). This region was covered during the Wisconsin stage. The earlier drift of this period extends to the Shelbyville moraine, which forms the southern boundary of this glaciation and is a definite feature of the landscape. In the extreme northeast, around Lake Michigan, the latest deposits of the state are to be found, and these differ considerably even from the Wisconsin drift farther to the south and east.

The loess deposits of the interglacial periods have affected the character of the lands in different parts of the state; for example, the deposits of this wind-transported soil are much thicker in the Illinoian drift of the west than in the south. In several counties west of the Illinois River the loess ranges from 10 to 30 feet in thickness, quite apart from the deep loess deposits on the banks of the Illinois and Mississippi rivers, where it sometimes reaches a thickness of 40 feet. In Southern Illinois, east of the Kaskaskia River, the well borings show that the loess deposits are very thin, 3 to 5 feet, and even less in many places.[3] These differences are reflected in the character of the land utilization, and in the lower crop yields and land values on the glaciated region of the south than on the glaciated region west of the Illinois River.

Physiographic Regions of Illinois

From these few remarks it will be seen that there are distinct physiographic regions in the state, due in part to the different ages and nature of the glacial deposits. Other agents have also been at work since the Ice Age and have modified the surface: for example, the wind, which, by carrying the finer rock materials, has built up thick post-glacial deposits; also water, which, by erosion, has exposed the bedrock of the country.

[3]Leverett, Frank, *op. cit.*, ch. 14.

The state seems to fall into the following physiographic regions, all of which can be subdivided:

1. The Driftless Areas (the northwest corner and the southern tip of the state) and the area of Kansan glaciation (Calhoun County).
2. The Illinoian Drift Sheet (south of the Sangamon River and the Shelbyville Moraine).
3. The Illinoian Drift Sheet (in the north and west of the state).
4. The Early Wisconsin Glaciation, or the Prairie Province.
5. The Middle Wisconsin Glaciation, or the Chicago Region.
6. The Illinois Valley.
7. The Limestone and Loess Regions of the Mississippi.

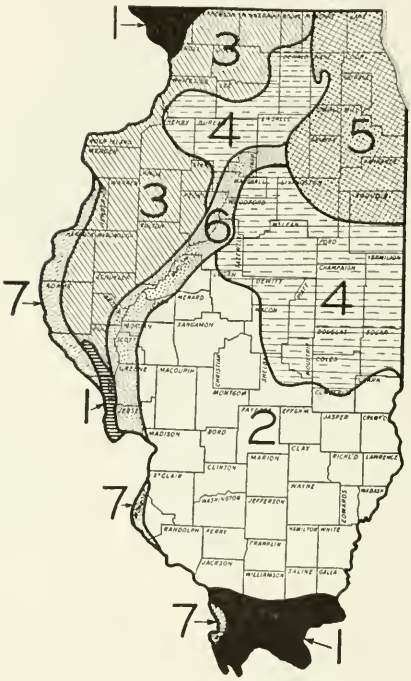

FIG. 3.—The physiographic regions of Illinois: 1, driftless areas, and area of Kansan glaciation; 2, Illinoian drift sheet, south; 3, Illinoian drift sheet, west; 4, early Wisconsin glaciation, or the prairie province; 5, later Wisconsin glaciation, or the Chicago region; 6, the Illinois valley; 7, limestone and loess regions along the Mississippi.

Climate and Vegetation

Climatic conditions and natural vegetation are also important in determining the boundaries of these geographic regions. The climatic regions are the result of latitudinal differences rather than any marked differences in altitude; so the isotherms and isohyets have, in general, an east-west trend, the only deflections being in the river valleys. There

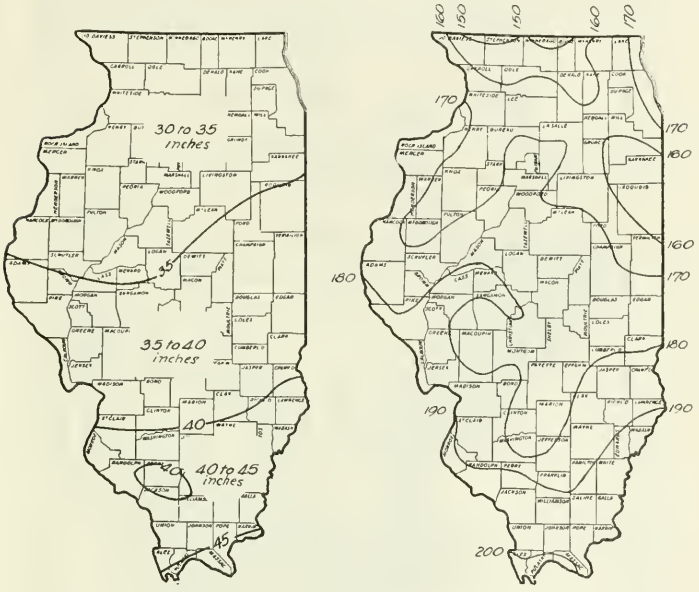

Fig. 4.—Maps of Illinois showing (a) average annual rainfall and (b) average length of growing season, that is, number of days without killing frost. There is a difference of about 15 inches rainfall between the extreme north and the extreme south, and the growing season in the southern tip of the state is 40 days longer than in the northern part. (Courtesy of Illinois Agricultural Experiment Station.)

is a difference of 10.7° F. in average annual temperature between the extreme north and south districts (47.2° in the north and 57.9° in the south). The rainfall also increases from north to south, there being a difference of 9.29 inches between the most northerly and southerly dis-

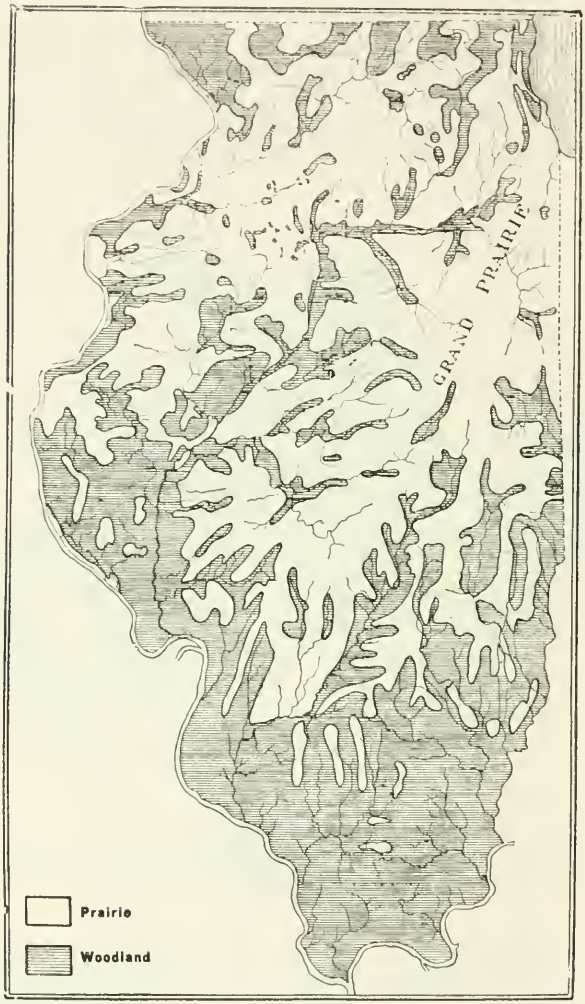

FIG. 5.—Map of Illinois showing natural vegetation. (From Sampson after Brendel.) (Courtesy of Illinois Natural History Survey.)

tricts.[4] Climatic influence is very marked in the Ozark Region, where the longer growing season and heavier rainfall affect the type of crops grown.

Originally about 42 per cent of Illinois was forested, the rest of the state being prairie. The chief forest areas were in the southern half of the state, and elsewhere along the river courses. The light-colored forest soils are less fertile than the prairie soils, and this accounts in part for the lower land values of areas they cover. The influence of climate and natural vegetation may be seen by comparing Figs. 4 and 5 (maps showing rainfall, growing season, and natural vegetation).

Geographic Regions of Illinois

The map of the geographic regions (Fig. 6) does not correspond to the physiographic, climatic, or vegetative regions; but in each geographic region these influences are reflected, in varying degrees, in the dominant human responses.

(1) *The Dairy Region.*—In this region the chief occupation is the raising of cattle, primarily for dairy purposes. The increasing demand of the nearby Chicago markets for fresh dairy produce and vegetables accounts for the growing importance of truck farming along with the cattle industry.

(2) *The Chicago Region.*—This region is dominated by the city of Chicago. Its level topography and its location, that of geographical nodality, have made this area one of the greatest route centers of the world. The ease with which food can be obtained, raw materials and fuel assembled, and manufactures distributed, has led to a great industrial development.

(3 and 4) *The Livestock Region and the Prairie Province.*—These together constitute the Corn Belt of Illinois. The large percentage of tillable land in these two regions has led to the development of grain farming, corn and oats being the chief crops. In the principal beef cattle and hog section of the state (Region 3 in Fig. 6) the corn is fed to the stock and then marketed in that condensed form. In the northeast of this region some grain is shipped to Chicago, while in the south fruit and wheat are grown, the former showing the influence of the milder winters as well as the nearness of St. Louis markets. In the prairie province (Region 4 in Fig. 6) the corn and oats are marketed chiefly as grain, owing to the nearness to Chicago; livestock taking second place. Dairying, however, is being carried on by an increasing number of farmers,

[4] Mosier, J. G., "Climate of Illinois," p. 22.

because of the growing demand of a large industrial population for fresh dairy produce. Agricultural industries, such as the manufacture of corn products and agricultural implements, are important, and are aided by the presence of coal deposits. Mining and the manufacture of clay products are carried on in the eastern counties of the prairie province, where there are good supplies of coal and clay.

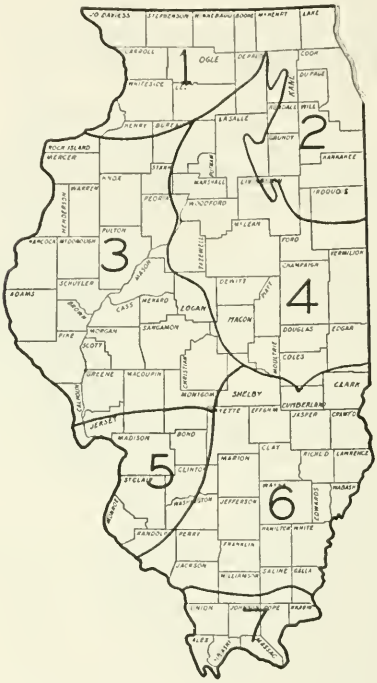

FIG. 6.—The geographic regions of Illinois: 1, dairy region; 2, Chicago region; 3, livestock region; 4, prairie province; 5, St. Louis region; 6, mixed-farming region; 7, Ozark region.

(5) *The St. Louis Region.*—St. Louis, East St. Louis, and their environs form an urban center which dominates this area and provides ready markets for dairy produce, poultry, fruit, and vegetables. The mineral industries of St. Clair and Madison counties add greatly to the im-

portance of this section of the state. Land and water routes converge on St. Louis, which is one of the chief bridge points of the Mississippi, as well as a collecting and distributing center for the surrounding region.

(6) *The Mixed-Farming Region.*—This region lends itself to subdivision, but mixed farming is the chief occupation. Soil conditions here are less favorable for large-scale grain production than in central Illinois. A large proportion of this area was originally forest rather than grassland, and to some extent this accounts for the soil being less fertile than that of the Corn Belt. The longer growing season (180-200 days) and good transportation facilities enable the fruit grown here to be on the Chicago markets considerably earlier than the local supplies of that city. The three leading coal-mining counties of the state are in the southern part of this region.

(7) *The Ozark Region.*—In the Illinois Ozarks the rough topography has been the dominating influence, although soil and climate have also played their part. The percentage of tillable land is low, and that of broken and hilly land is correspondingly high. Thus non-tillable land makes up 79 per cent of Hardin County, 67 per cent of Johnson County, and 42 per cent of Massac County.[5] The soil is mostly thin, and poor, as most of this area was originally wooded, but the climate and hilly nature of the country and the low price of the land have fostered the fruit-growing industry. Corn is grown on the Ohio and Mississippi bottoms. The nature of the topography, resulting in poor transportation, is one of the chief causes for the arrested development of this region.

[5]Mosier, J. G., and Gustafson, A. F., "Washing of Soils and Methods of Prevention."

CHAPTER II

GLACIATION AND ITS INFLUENCE UPON TOPOGRAPHY

The title, "prairie province," is here used to signify approximately the area of early Wisconsin glaciation in Illinois, extending from the Marseilles moraine in the north and including the Shelbyville moraine in the south, which also swings round and forms half of the western boundary, the other half being completed by the Bloomington moraine. This area of early Wisconsin glaciation is surrounded by the region of Illinoian glaciation on the west and south, while the Chicago region, or area of Mid-Wisconsin drift, lies to the northeast.

The word *prairie* was the original French word meaning meadow tract. The early French settlers had nothing in their homeland to correspond to the extensive grassy plains of Illinois. The grasslands they were familiar with were meadow lands. The early historians speak of Illinois as the "Prairie State," and of this particular area as the "Grand Prairie." Gerhard locates the Grand Prairie on his map showing the natural vegetation of the state (Fig. 5), and of the prairie he writes: "Those who have not yet seen a prairie should not imagine it like a cultivated meadow, but rather as a heaving sea of tall herbs and plants, decking it with every variety of color." Later he continues: "We find the greatest prairies in the northeastern part of the state, stretching from the Illinois River to the State of Indiana, at intervals intersected by the shaded course of a river but entirely destitute of trees on its highest points, whence in all directions flow little brooks to meet the Illinois and Wabash."[1] The term *prairie* is now frequently applied to grassy and generally treeless plains, but it is usually restricted to areas so characterized in central North America.

The glacial features play an important part in fixing the boundaries of the prairie province. The Shelbyville moraine, which marks the limit of the early Wisconsin glaciation on the south and southwest, is taken as the boundary of the geographical region. The Bloomington moraine is used as the western boundary of the prairie province, although the Wisconsin ice sheet is now known to have extended west of that morainic ridge in two areas — the Green River lobe and the Belvidere lobe.[2] (See Fig. 7.) Here the soil and natural vegetation must also be taken into account, and the reason for limiting the geographical province by the

[1]Gerhard, Frederick, *Illinois as It Is*, p. 230.
[2]Leighton, M. M., "Differentiation of the Drift Sheets of Northwestern Illinois," pp. 265-281.

Bloomington moraine is seen in the difference in crop yields and land values resulting from the change from rich prairie land east of the moraine to the sandy soils west of the moraine, on which the natural vege-

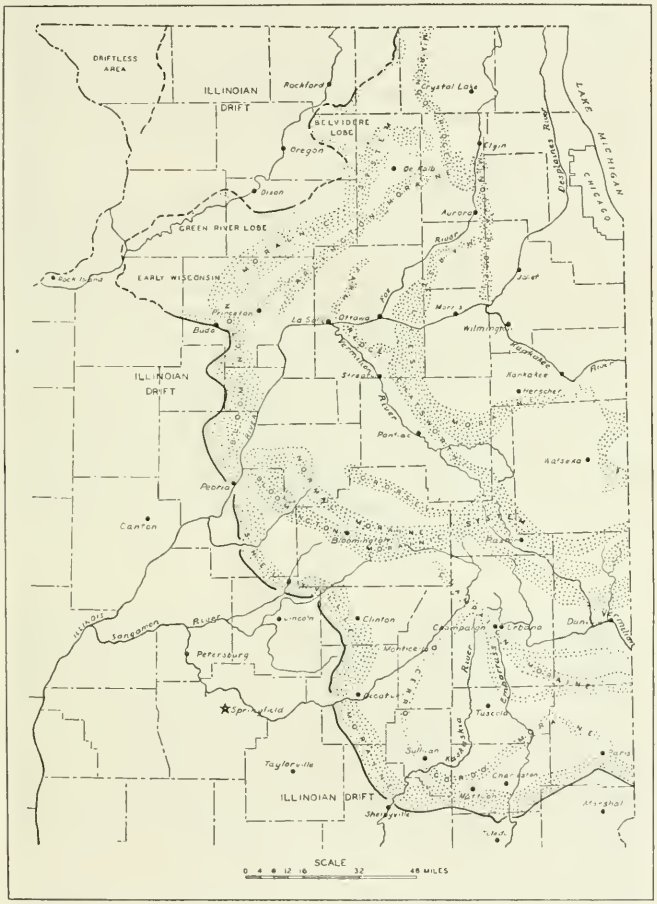

FIG. 7.—The glacial geology of northeastern Illinois. (Courtesy of Illinois Geological Survey.)

tation was chiefly sand-binding grasses and the black oak. The prairie province is limited on the north and east by the Marseilles morainic system and by the sandy area of the late swamp and bottom lands in northern Iroquois County; this area, now drained, resembles the old swamp lands in Kankakee and Grundy counties, and with them is included in the Chicago region. The boundaries of the province do not, of course, follow the county boundaries, but the following counties are entirely within the region: Vermilion, Champaign, Douglas, Coles, Moultrie, Piatt, McLean, La Salle, Putnam, Marshall, and Woodford. Parts of several counties are also included, namely: Edgar, Macon, De Witt, Tazewell, Bureau, Livingston, De Kalb, Ford, and Iroquois.

As has been noted, the Wisconsin ice sheet is the most recent of the four which invaded the territory now comprising Illinois. It is the most important of all the glacial stages, not because the drift was greater in extent or thickness, but because the drift deposits are the last and have been extensively preserved. The interval since the occurrence of this last glacial stage has been so brief that but little modification of topography, drainage, or soil has been possible. The prairie province was entirely covered during this stage, and it is to the morainic ridges and intervening ground moraine that the province owes its topography, that of an undulating plain. The Wisconsin drift is characterized by large morainic ridges and comparatively smooth till plains. The moraines are of topographic importance and have served to modify or form the divides between the smaller rivers. They fill a number of pre-existing river channels and deflect some of the streams. The concentric trend of the ridges is to be ascribed to the lobate character of the ice margin.

Shelbyville Moraine

The outer border of the Wisconsin drift sheet is found in the Shelbyville moraine, which is the thickened edge of this drift sheet that extends apparently many miles to the north beneath the later moraines; for the drift which characterizes this moraine is found below the base of the later moraines of the northeast of Illinois. There is an imbricate arrangement of the drift sheets by which the later, to some extent, overlap the earlier. The Shelbyville moraine extends through central and eastern Illinois and western Indiana. It receives its name from the city of Shelbyville, situated on the extreme southwest of the morainic loop. This thickened edge of the drift has a breadth of several miles and merges into the plain on the inner border. The crest is usually found within one or two miles of the outer border.

From the Illinois-Indiana line the moraine extends west to Shelbyville, then turns northwest, passing west of Decatur and Clinton. The

following villages are situated near the outer moraine border: Nevis, Westfield, Janesville, Trilla, Paradise, Windsor, and Shelbyville. The cities of Paris, Charleston, and Mattoon are near the inner border. Macon, Harristown, Warrensburg, Waynesville, Atlanta, and Delavan are on the moraine. At Delavan it swings northward and crosses the Illinois River, just north of Peoria, and is merged with what has been considered a later moraine—the Bloomington—and appears to be covered with the Bloomington drift throughout northern Illinois.

Throughout most of its course in Illinois the Shelbyville moraine presents a bold relief when viewed from beyond the outer borders. It is seldom less than 60 feet, and averages about 75-100 feet, above the till plain. The greatest relief (150 feet) is found in Edgar County, between Paris and Kansas. At Kansas, 20 miles from the Illinois-Indiana line, the height of the moraine is 839 feet above sealevel; while between the Sangamon River and Peoria the crest rises to 800 feet in several places, and rarely falls below 700 feet.

With the exception of the surface portion which varies because of local deposits of silt, sand, and gravel, the drift in this moraine is typical till. A blue clay, moderately stony, constitutes the main body of the till, and in Illinois it ranges from 60 to 150 feet in thickness. It grades into yellow till in the weathered zone.

The surface portion of the yellow clay, to a depth of 4-6 feet, is more highly oxidized and shows greater discoloration than the lower portion, and contains but little calcareous material. These features seem to be due, in the main, to weathering subsequent to deposition, and not to original differences.

Surface bowlders, almost entirely of Pre-Cambrian rock, are distributed over the moraine. They are occasionally so numerous as to be a hindrance to agriculture. They are most conspicuous in the southwest of Edgar County. The moraine is covered with a silt surface, which has a depth of 5-6 feet, north of Shelbyville, where it completely conceals the bowlders. East of Shelbyville, where this covering is only 1-2 feet thick, the bowlders are exposed.

The silt is brownish-yellow in color, paler than the oxidized till beneath it. It is usually leached to a depth of 3-4 feet, but where thickest it is calcareous in the lower portions. It appears to have been deposited very soon after the till which underlies it, for the latter is not leached.

Beneath the Shelbyville drift lies the Illinoian drift. The junction of the two is marked by clear indications of an old soil surface. Well drillers find the old drift much harder than the young drift on top. The Shelbyville drift is much thicker in Illinois than in Indiana, and averages approximately 100 feet, but it varies very much. At Charleston it is 127

feet, while at Decatur it is 140 in one shaft and 106 in another. The differences are partly due to erosion and partly to original inequalities of thickness.

The silty loam which covers the outer slope of the moraine points to sluggish drainage from the ice front. The absence of vigorous outwash from the Shelbyville ice edge, even along such favorable lines as those afforded by the Illinois, Sangamon, and Kickapoo valleys, suggests that the marginal ice must have been disposed of in some other way than by melting, for instance by evaporation.[3] This would seem to demand an arid or semi-arid climate in central Illinois at the time.

The Inner Border Tract

The topography for some distance north and east from the border of the Shelbyville edge is of a gently undulating type and not very different from that of the thickened border. On the east side of the Illinois River the Shelbyville and Bloomington moraines are closely associated at the east bluff of the river, but a few miles to the southeast they become separated by a distance of 10-12 miles, and continue to have this interval between them until the Mackinaw River is reached; then the Shelbyville moraine bends south and the Bloomington east. The plain between them is from 40 to 60 miles wide and is crossed by ridges of the Champaign and Cerro Gordo moraines. This tract, bounded by the Shelbyville moraine on the west, the Bloomington moraine on the north, and the Sangamon River valley on the east, is underlain by a thick deposit of drift. Several well drillings show that here the Shelbyville drift is 100 feet thick.

The Cerro Gordo Moraine

The Cerro Gordo moraine starts in Champaign County near Mahomet and extends southwest into Piatt County through Monticello and Cerro Gordo where it swings away from the Sangamon River. A morainic belt which crosses the Kaskaskia valley at Sullivan and continues towards Mattoon, where it approaches very close to the Shelbyville drift edge, may be the continuation of the Cerro Gordo moraine. It joins a ridge that bends northeast through Coles and Douglas counties, southeast through Edgar County, and leaves the state just north of the Shelbyville moraine. The distance between the Cerro Gordo and the Shelbyville moraines varies greatly; near Mattoon and Paris they are closely associated, while at Mahomet they are 25-30 miles apart. There is much variation in the thickness of the Wisconsin drift in this moraine. At Cerro Gordo it is 150 feet deep, and at Monticello it is only 20 feet.

[3]Barrows, H. H., "Geography of the Middle Illinois Valley," p. 38.

The Champaign Morainic System

In the Champaign morainic system there is a group of ridges which interlock to some extent but usually consist of two or three separate members. These are more or less distinct east of the city of Champaign but form a single ridge west of that city. At Champaign one branch extends south as the Savoy Ridge, also called the outer ridge, and the other southeast, forming the Yankee Ridge, which in its turn divides to form the Homer (or inner) Ridge and the Broadlands (or middle) Ridge. The outer and middle ridges unite again and form a single ridge which continues along the border between Edgar and Vermilion counties until it reaches the state boundary. The northwestward extension is a single ridge extending from Mahomet, called the Blue Ridge.

As seen in profile, the ridges of the Champaign system rise with nearly as rapid slope on the inner as on the outer border—a feature that distinguishes them from nearly all other moraines of the Wisconsin series, which characteristically present a long inner slope and a somewhat abrupt outer slope. On the whole the ridges of this system are of a type that may best be designated the smooth-ridge type, the surface undulations being very gentle, while the crest is usually well defined.

In northeast Piatt County the crest of the Blue Ridge reaches a height of 820 feet above sea level, the relief being about 90 feet, though it is usually about 60-75 feet. The Savoy Ridge has a relief of 45 feet on the outer border and 40 feet on the inner border. The middle ridge has a relief of 25-30 feet on the outer and 20 feet on the inner border. The inner ridge is a single elevation extending southeast from Champaign and due east across Vermilion County. Throughout its entire course the relief is but 15-20 feet except where knolls rise above the general level of the crest.

These morainic ridges are composed mainly of till. Gravel and sand beds are occasionally found on the knolls and near the level of the base of the ridges, but only to a limited extent. Gravelly knolls are found on the inner slopes of the moraine near Champaign and Urbana. This morainic system is characterized by a number of surface bowlders, the majority of which are crystalline, and of Canadian origin. Several large blocks of limestone, however, are found on the surface in Champaign County.

The surface of the ridges of the Champaign system, as well as the plains between them, is commonly covered with a pebbleless clay loam 2-4 feet in thickness. This has probably concealed many bowlders that would otherwise have been exposed. The number of bowlders on the surface is less than on the plains between this morainic system and the Cerro Gordo moraine.

As a rule, the plains outside the ridges of this morainic system show scarcely any sand or gravel outwash from the moraine, and there appears to have been only a gentle movement of waters from the ice edge southward down the valleys. Kaskaskia and Embarrass valleys have, as a rule, either silt or till sides where they border the ridges of this morainic system, and it is probable that there was only feeble outwash in these valleys.

Between the ridges of this morainic system there are till plains ranging from one or two to about ten miles in width. The surface of these plains is generally smoother than that of the moraines. One of these plains lies between the inner ridge of the Champaign system and the outer ridge of the Bloomington system and is 15 miles wide in some places.

The Bloomington Morainic System

This series of four morainic ridges receives its name from the city of Bloomington, situated on one of the two main ridges. They interlock in some places, and in others the two weaker ridges fade out. At some points the two larger ridges divide, to form four separate ridges, apart from the two weaker ones. In northwest Peoria County this system is united with the Shelbyville system, so that the latter is no longer traceable to the north of the junction.

The northern end of the Bloomington system appears to be near the western border of Kane County. It extends across De Kalb and Lee counties in a southwesterly direction and turns south through Bureau County. In these counties there are two definite ridges, together about 12 or 14 miles in width. The weaker inner members of the system are undeveloped thus far. The inner ridge dies out in Bureau County and the larger one passes south into northeastern Peoria County. Crossing the Illinois River, it continues southeast through Tazewell and Woodford counties and into McLean County in two prominent ridges and a weak one, Cropsey Ridge, to the north. These three come together in Ford County where a re-entrant angle is formed north of Gibson City. From Ford County three parallel ridges extend southeast into Vermilion County. A fourth and weak ridge swings north and northwest into Livingston County.

The average relief of the Bloomington moraine is about the same as that of the Shelbyville moraine, namely, 75-100 feet. It is least (50 feet) in Ford and Champaign counties and greatest (150-200 feet) in southern Lee and northern Bureau counties, where the moraine is bordered on the west by the Green River basin. The Bloomington moraine differs from the Shelbyville in that the relief of the inner border of the moraine is often as marked as that of the outer border.

The outer ridge of the system maintains a strong relief of about 100 feet throughout Bureau County. In southern Bureau, western Marshall, and northeastern Peoria counties, it rises to 150 feet above the land between it and the Illinois valley. This prominent ridge probably includes both the Shelbyville and the Bloomington systems, for the former separates from it in eastern Stark County.

Upon crossing the Illinois into Woodford County, the crest of the moraine is only slightly higher than the land on the inner border, and the descent eastward seldom exceeds 25 or 30 feet to the mile. The small Cropsey Ridge, which crosses northern McLean County, has a relief of but 30-50 feet on its outer border and a very gradual descent on its inner border.

The range in altitude of this moraine is about 300 feet, its highest points being slightly over 1,000 feet above sea-level, while few points apart from the valleys fall below 700 feet. The range in altitude of the crest for each county is given below:

County	*Feet*	*County*	*Feet*
De Kalb	875–975	Tazewell	700–825
Ogle	875–940	McLean	775–913
Lee	900–1025	Ford	775–860
Bureau	700–989	Champaign	750–830
Marshall	800–900	Vermilion	680–790
Peoria	700–830		

In the section of the moraine which extends from western Kane County to Bureau Creek, there is scarcely a mile in which knolls of 10-20 feet in height are not seen, and also shallow basins containing ponds. There are three narrow belts of morainic material in Bureau County: an inner and outer and a rather indefinite middle ridge. In south Bureau and on through Marshall and Stark and south through Peoria County to the Illinois River, the ridge is a strong feature four to six miles wide and 100 feet or more in height above the plain on the west. There are knolls along the crest, and shallow basins are common in this section.

The section between the Illinois and the Mackinaw rivers has a well-defined outer, or southwest, border but merges on the northeast into a gently undulating tract. The southwest face of the ridge presents a series of drift billows 20-30 feet in height, among which are sags and shallow basins.

East of the Mackinaw, near the borders of Woodford, McLean, and Tazewell counties, the Bloomington system presents two well-defined ridges which are separated by a narrow plain one or two miles in width. These are maintained eastward to Padua, where they unite and continue as one ridge extending east to the Ford County re-entrant. Before reaching Padua, the outer ridge is crossed by several streams which have their sources in the inner ridge; among these are three head streams of the

Sugar Creek, two of the Kickapoo, and one of the Salt Creek. The Sangamon River also leads through it in an easterly direction from near Padua, where the two ridges join. Between the river gaps the crest of the moraine is well defined and gently undulating. It lies near the outer border of the moraine, being as a rule much more abrupt on the outer face than on the inner. The crest varies in height, its highest points being about 900 feet above tide and its lowest about 800 feet.

In the re-entrant angle in Ford County the ridges on the west are crowded together in a single belt, but those on the east are partly separated by strips of marshy land. The topography of the re-entrant portion is of a gentle swell-and-sag type, with undulations of only 15 or 20 feet. The ridges have definite crest lines standing about 50 feet above the marshy plains which separate them. In southeastern Livingston County at the extreme north end of the re-entrant, a sharp knob-and-basin topography is developed, in which knolls rise 30-40 feet above the basins enclosed by them. There are several small lakes and ponds among the morainic knolls.

In the section of the Bloomington system extending east from the re-entrant angle to the Indiana boundary, the ridges are grouped in two belts. The outer belt, throughout its course in southern Ford and northeastern Champaign counties, consists of a single broad ridge, called the Gifford Ridge, its surface varying in height 20-30 feet. Upon entering Vermilion County, the outer belt displays a double crest line, and in the eastern part of the county it is separated into two ridges, between which there is a narrow plain, a mile or more in width, that is drained by Stony Creek. The moraine varies 75-100 feet in altitude in Vermilion County but the variations are not abrupt, a range of 50-75 feet occurring within a distance of two miles or more. It rises abruptly on its south border, especially in the western part of the county.

The second, or inner, ridge has a well-defined crest and forms the divide between the Iroquois and Vermilion rivers. There is a minor ridge south of the inner one. Its topography is weak but is similar to that of the main inner ridge to the north, having a gently undulating surface with few knolls more than 20 feet in height. These three ridges are separated by narrow plains two or three miles in width.

The thickness of the drift in the Bloomington system averages 75-100 feet along the ridges and has a maximum of about 200 feet. The thickness is 50 feet or less between the ridges and on the plains to the north and east of them.

In determining the lower limits of the Wisconsin drift, there are two lines of evidence. One is the abrupt change in texture of the drift, the Wisconsin being fresh and soft while the underlying sheets are much

harder. The other is the occurrence of beds of peat and black soil, produced at the surface of the lower or buried sheet of drift prior to the deposition of the later drift. Where the two lines of evidence are found together, it is easy to decide upon the line of contact between the Wisconsin and Illinoian. Well drillers have recognized the two sheets even where the black soil or peat has not been preserved.

Buried soils are found at varying depths below the Wisconsin drift. In Kane County these soils appear beneath a plain southeast of Burlington, at a depth of only 40 or 50 feet. This is thought to be soil of the Peorian interglacial stage.

At a coal shaft at Minonk in the eastern part of Woodford County the Wisconsin drift is only 62 feet thick. In northern Tazewell County this drift ranges in thickness from 50 to 150 feet. In northwestern McLean County instances of buried soil and a change from hard to soft till are found at a depth of 150 feet beneath the crests of the morainic ridges and at an elevation of 650 feet above tide.

Buried soils are well preserved along the course of much of the Bloomington system east from the Illinois River, their occurrence in well sections being more numerous than in districts to the north except limited areas in Bureau, La Salle, and Kane counties. There is scarcely a township in which the junction of the Wisconsin drift with older drift cannot be ascertained through the presence of buried soils or by a change in the till.

The great mass of till composing the moraines of this system, together with the plains between them, consists of a soft blue till, moderately stony and markedly in contrast with the hard till found beneath it. This till is very adhesive; the underlying hard till is far less so. The surface portion of the drift is oxidized to a depth of six to ten feet and has a brownish color. There are occasional patches of a pink-colored till, which in some places extends to considerable depths, but usually the blue color occurs within a few feet of the surface.

There are beds of sand and gravel, often of considerable extent, at various depths in the till. These afford a supply of water for many wells (of no great volume, however). The outer face of the moraine in Lee County and northern Bureau County is heavily coated with sand. Sand also covers the inner slope of the moraine in northern Vermilion County and west of the re-entrant angle in Livingston County. It is probable that the sand deposits in these two localities are glacial outwash, or they may be accounted for by the presence of temporary glacial lakes held in front of the retreating ice, whose waves worked upon the surface of the till sheet and formed these sandy beds.

The surface of this morainic system from De Kalb County south to

Bloomington is covered with a silt, which resembles loess in appearance, to a depth of 2-4 feet. This surface covering was apparently deposited within a short time after the retreat of the ice sheet, for the underlying till suffered little leaching prior to its deposition.

Surface bowlders are not numerous in this morainic system, and are found only where there is not enough sand and gravel to conceal them. In this respect the Bloomington system resembles the other moraines of the Wisconsin series. There are, however, some bowlders on the outer face of the outer moraine in southeastern Lee County and at a few points in Bureau, Marshall, and Peoria counties. They are a serious hindrance to tillage on some of the farms in these areas.

The bowlders vary from 2 to 10 feet in diameter. Granite predominates over other classes of rock, and there are a few limestone erratics. Greenstones and quartzites are also common. Several large limestone blocks have been found in Vermilion County quite near the surface, which resemble the stone of which there is an outcrop about thirty miles to the north; but generally speaking the bowlders of local and semi-local rocks are buried deep in the till.

The Intermorainic Tracts

The intermorainic tracts are the plains and gently undulating tracts among the ridges of the Bloomington system and the Marseilles moraine. They are of greater extent than the morainic tracts, as the latter are restricted to narrow belts. About 90 per cent of the area between the inner border of the main ridges of the Bloomington system and the outer border of the Marseilles system is here classed as intermorainic.

The portion north of the Illinois River, including southwest Kane, southeastern De Kalb, northwestern La Salle, and eastern Bureau counties, shows a marked descent from northwest to southeast. Aside from the narrow morainic belt which traverses this plain from Utica northward to Earlville, the surface is only slightly undulatory, as a rule. There are a few short eskers, and scattered knolls ten or twenty feet in height, all of which rise somewhat abruptly above the plains.

South from the great bend of the Illinois River the features are more varied. The narrow strip on the west of the Illinois valley descends rapidly from the moraine to the river bluff. It has a gently undulating surface with a tendency to north-south ridging. East from the Illinois valley there are plain tracts interrupted by undulatory surfaces which strongly resemble slight moraines. These undulatory tracts are most noticeable in a belt a few miles in width which extends southward from the bend of the Illinois River through eastern Putnam, Marshall, and Woodford counties, its eastern edge being near the divide between the

tributaries of the Vermilion and the streams that flow westward to the Illinois. There is a marked descent from the crest of the divide (700-750 feet) to the borders of the Vermilion River north from Pontiac (620-640 feet above tide).

In northern McLean County there is a tract between the inner borders of the main ridges of the Bloomington system and the upper Mackinaw River valley, which is gently undulating and dotted by occasional well-defined knolls 20 or 30 feet in height. It has a marked northward descent, the Mackinaw River being 50 to 100 feet below the inner border of the moraine. North from the Mackinaw, as already stated, is the well-defined Cropsey Ridge, crossing the country in a northwest-southeast direction. From this ridge there is a gradual northeast descent toward the Vermilion River. The greater part of the surface is gently undulating. There are a few knolls and ridges of sand, 10-20 feet in height, in southern Livingston County, but these are probably the result of wind action rather than glacial action.

East from the reentrant angle of the Bloomington system there is a plain which covers the greater part of Iroquois County. It is bordered on the north by the Marseilles morainic system, on the east by the Iroquois River, and on the south by the inner Bloomington ridge. This plain descends to the north, its altitude at the inner border of the Bloomington moraine being about 700 feet, and in northern Iroquois County only 625-650 feet. There are several sandy ridges in western Iroquois County and numerous dunes in the eastern part. Some of these ridges appear to be beaches of a former temporary lake. The dunes are probably the result of wind action or the sand deposits of the lake bottom.

The thickness of the Wisconsin drift on these intermorainic tracts is much less than on the morainic ridges and probably does not average more than 50 feet. In southern Kane County and southwestward along the Fox River it is about 20-40 feet. In De Kalb, La Salle, and Bureau counties it is often 50-100 feet or more, but in Vermilion County it is scarcely 50 feet. In Iroquois County it is 50-100 feet. In most of the intermorainic area the Wisconsin drift consists mainly of a rather stony, soft, blue till similar to that of the moraines. This till is replaced by sand or gravel deposits along the line of eskers which occur in Kane and De Kalb counties. On the banks of the Vermilion River in Livingston and La Salle counties, sand and gravel deposits predominate over the till. With these few exceptions the till greatly exceeds the sand and gravel. The drift is capped only by thin deposits of silt, often too thin to conceal the surface bowlders.

The deposits of Illinoian drift under the Wisconsin appear to vary more than the younger drift. The outcrops of the older drift along the

valleys tributary to the Illinois River often expose a cemented gravel. In some places along the Illinois the older drift is largely composed of sand and gravel, but as a rule till predominates.

Eskers

One of the most interesting eskers in Illinois is found in the southern part of Kane County. Its eastern terminus is about three miles west of the city of Aurora, while its western end is near the village of Kaneville, from which the esker takes its name. The esker occupies a trough-like valley cut in glacial deposits. It is probable that the valley was formed by the same stream that deposited the esker, since they coincide so nearly in trend and position. At the western end of the valley there is an extensive delta, apparently built up by the same stream. The valley is now followed by the Blackberry Creek in the reverse direction from the supposed flow of the glacial stream which produced the excavation and formed the esker and delta. The delta occupies an area of about eight square miles. It stands a few feet higher than the till plains which border it on the west, north, and south. In the village of Kaneville, which is situated in the center of the delta, the wells are usually in gravel to a depth of 30 or 40 feet. There are numerous small excavations in the esker which show it to be formed of sand and gravel in nearly horizontal beds. Few bowlders are to be seen on the esker, and these are in a slight depression in the crest. They are all of archean rocks. The greater percentage of archean rocks on the surface, than in the deeper portions, both of eskers and till sheets, apparently indicates that the source of the bowlders was different from that of the main body of the drift. Probably they were carried at a higher level in the ice.

Another esker about one and a quarter mile in length, known as the "Devil's Backbone," is located in De Kalb County, not far from Little Rock Creek.

CHAPTER III

SURFACE WATER AND GROUND WATER

Precipitation and Run-Off

Illinois lies in the belt of prevailing westerly winds. Much of the rainfall comes in moderate or gentle rains, during which a large proportion of the water enters the soil. In the summer, however, there are very heavy rains, and as the soil is unable to absorb so much water in such a short time, much of it runs off the sloping land as surface drainage. The maximum rainfall comes in the spring and summer months, when the soil is in the best condition to absorb water; but in spite of this fact there is an enormous run-off from the rolling land. Snowfall is also important in this connection. The ground is not generally frozen when it is covered with snow. The average monthly temperature of the soil to a depth of one to three inches is higher than that of the air. Experiments show that the temperature on top of snow is from 11 to 15 degrees lower than the ground under a four-inch snow. In general, then, there is less run-off as the snow melts and sinks into the ground than there is in the same amount of rainfall. If the soil is frozen, however, and rain or sleet falls, the run-off frequently produces a flood.[1]

The amount of run-off and the effect which it has depend to a large extent upon the character of the soil and subsoil, the length and steepness of the slope, the tillage practiced, and the type of vegetation. Because these conditions vary so widely, it is difficult to compute the amount of the run-off. Considerable work, however, has been done along these lines by Mr. F. H. Newell, formerly Chief Hydrographer of the United States Geological Survey. He estimates that, for broad valleys and gentle slopes in open country, a mean annual rainfall of 50 inches gives an annual run-off of about 25 inches, or 50 per cent of the total rainfall. Where the rainfall is 40 inches, the run-off is about 15 inches, or 37.5 per cent; and where the rainfall is 30 inches, the run-off is about 8 inches, or 26.6 per cent. Greenleaf estimates the run-off for the Illinois River basin, with its extensive area of level to gently rolling land, at about 24 per cent of the total rainfall of the catchment area, and Leverett estimates the run-off for the State of Illinois at about 21 per cent of the rainfall. In the following tabulation, the run-off of rivers in different parts of the

[1]Mosier, J. G., and Gustafson, A. F., "Washing of Soils and Methods of Prevention," pp. 22-24.

United States may be compared with that of two of the chief rivers of the prairie province, namely, the Embarrass and the Kaskaskia.[2]

River Basin	*Percentage of Rainfall Carried off in Drainage*
Connecticut	56.6
Potomac	53.0
Savannah	48.9
Kaskaskia	37.9
Embarrass	25.0

Of the river basins mentioned in this list, that of the Connecticut has the highest percentage of rainfall carried off in drainage; this is largely due to the fact that most of the area drained by this river and its tributaries is ice-scoured. The bedrock is close to the surface, and the soil is very thin; consequently much of the rainfall flows off in surface drainage. Added to this, the Connecticut valley has been largely deforested—which also increases the run-off. The Savannah River rises in the Southern Appalachians, and through more than half of its course traverses mountain and plateau country. The Potomac has its source in the Allegheny section of the Appalachian Plateau, so that this river also flows over more rocky surface with steeper gradients than those found in the basin of either of the two rivers of the prairie province. That the Kaskaskia River has a larger run-off than the Embarrass is due, in part, to the fact that after the former river leaves the Wisconsin glaciation of the prairie province in the lower two-thirds of its course, it traverses a region of the older Illinoian glaciation which has a heavy impervious clay subsoil; hence the percentage of the run-off is greater than in the Embarrass valley, where the soil conditions are different.

Running water is a powerful agent for loosening and carrying away soil material. The erosion produced by run-off is of two kinds: (1) sheet erosion, or general surface washing; and (2) gullying, of which there are two phases, (a) head-water erosion and (b) waterfall erosion. In sheet erosion the water moves over a uniformly sloping surface, and if the soil and vegetative covering are uniform, the amount of material removed will be practically the same for all points. This form of washing results in the removal of the surface soil and in the gradual reduction of fertility. It occurs to greater or less extent in practically every field. Usually, however, the slope is not uniform, but contains small draws in which the water collects, giving to the run-off greater velocity and consequently greater erosive power owing to concentrated action on a small area. The water flowing in these draws soon forms a gully, the eroding action of the water increasing the steepness of the upper slope, and the gully gradually "eats" its way up the slope by "headward erosion."

[2] *Ibid.*, pp. 517-519.

The waterfall type of erosion may occur where the surface material to a depth of two to four feet is more resistant than that beneath. A waterfall may start where water runs into a ditch or ravine; the undermining action of the water as it falls over the low precipice causes masses of the surface to break off and fall into the gully. This loosened material is carried away and the process repeated. By this means the waterfall slowly moves up the slope, leaving a narrow gully with steep sides. These waterfalls most frequently occur in pastures where the grass roots make a resistant surface. The unprotected outlet of a tile ditch may furnish the necessary beginning, especially where the water at the end of the tile has a drop of several feet.

TABLE 1.—APPROXIMATE AREA OF BROKEN AND HILLY LAND IN SEVERAL COUNTIES OF ILLINOIS COVERED BY THE SOIL SURVEY*

County	Area of Broken and Hilly Land (sq. mi.)	Percentage of Total Area of County
Bureau	79.80	9.00
Champaign	3.06	.31
De Kalb	.43	.07
De Witt	19.00	4.75
Douglas	1.50	.36
Edgar	45.41	7.36
La Salle	41.12	3.55
Livingston	1.50	.15
McLean	27.43	2.35
Macon	19.30	3.36
Moultrie	2.19	.64
Tazewell	67.18	10.39
Vermilion	36.00	4.05
Jo Daviess	421.00	64.00
Johnson	227.07	67.60
Hardin	132.90	79.10
Pike	381.78	47.79

*From Mosier and Gustafson, "Washing of Soils and Methods of Prevention," p. 514.

In Illinois about five and a half million acres of land (approximately 15 per cent of the area of the state) are rolling or hilly and subject to serious erosion. Fortunately for the prairie province, less of this land is found in it than in other parts of the state. The area of undulating timber soil in Illinois is practically the same as that of the hilly land, as will be shown later, and as the prairie province is mostly prairie it follows that the percentage of broken and hilly land is lower than in the northwest and in the south of the state. Table 1 shows the percentage of this type of land in the thirteen counties in the prairie province that have been covered by the detailed soil survey, together with the percentages in selected counties in other parts of the state, made by the same survey. (See Fig. 8.)

Besides the broken and hilly land, there is a large area of undulating to rolling land, both timber and prairie, that has not been badly damaged as yet, but with continued cropping and consequent loss of organic matter is becoming more and more subject to injurious surface erosion.

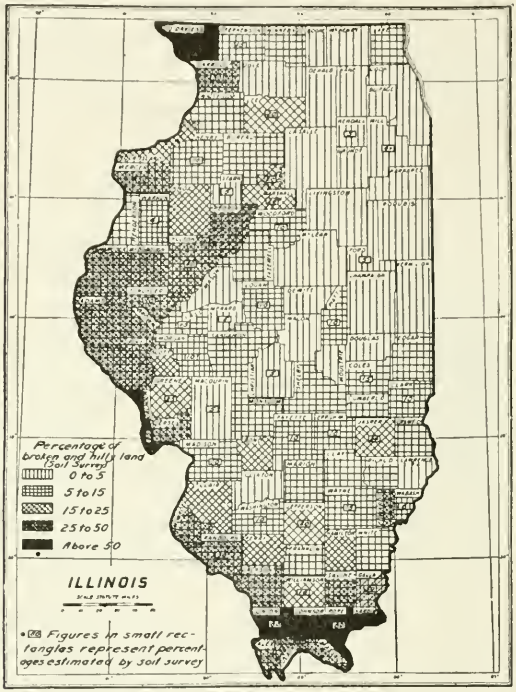
Percentage of broken and hilly land (Soil Survey)
0 to 5
5 to 15
15 to 25
25 to 50
Above 50
ILLINOIS
Figures in small rectangles represent percentages estimated by soil survey

Fig. 8.—Map of Illinois showing percentage of broken and hilly land in each county. Most of the counties of the prairie province have less than 5 per cent of such land. As a result of the level topography, there is less danger from erosion in the province than in other parts of the state. (Courtesy of Illinois Agricultural Experiment Station.)

Effect of Vegetation on Erosion

As will be shown later, prairie vegetation is evidence of relatively poor drainage, but one of the effects of organic matter in the soil is to keep it loose and porous, and in this condition the run-off is greatly

reduced. In general, upland timber soils have less organic matter than the prairie types; hence this latter type of vegetation tends to prevent serious erosion.[3]

Some important data showing the effect of different cropping systems and tillage on soil erosion have been obtained at the Missouri Experiment Station, Columbia, Missouri, where the following experiments were made: Seven plots, each one-eightieth of an acre in area, were laid out on a phase of the Shelby loam soil. The slope of the land averaged 3.68

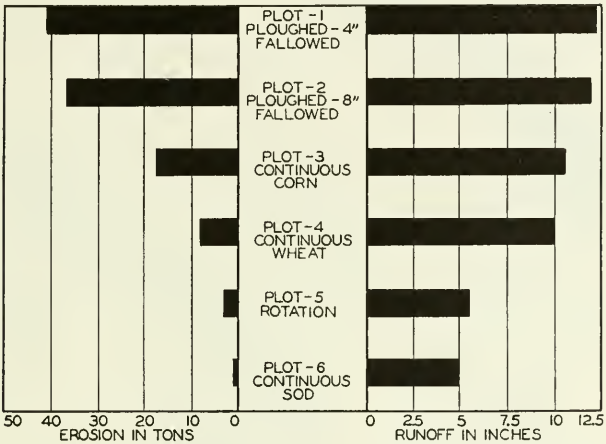

Fig. 9.—Graphs showing erosion of soil and runoff of rainfall from six plots of land under different systems of cropping and tillage. Plowed and fallowed land (Plot 1) allows the greatest amount of erosion and runoff, while a sod covering (Plot 6) allows the least amount. The land on which these measurements were made is a poor phase of Shelby loam with a slope of 3.68 per cent, and the results have a rather wide application in the Corn Belt. (Data from M. F. Miller.)

per cent. At the lower ends of the plots were concrete tanks for collecting the run-off and eroded soil which were determined after each rain. The results of these experiments showed that grass or clover land absorbed much more water than cultivated land. Deep ploughing (8 inches) was only slightly more effective than shallow ploughing (4 inches) in preventing run-off and erosion. The amount of rainfall absorbed by uncropped land, or land in a cultivated crop like corn, was practically con-

[3] *Ibid.*, p. 528.

stant from year to year, even with considerable variation in the annual precipitation. The influence of a crop in decreasing the rate of both run-off and erosion is very striking. Even continuous corn, cultivated in practically the same manner as the fallow plots, shows less run-off and much less erosion than the fallow land. Continuous wheat permits slightly less run-off than the continuous corn, but much less erosion. The influence of the rotation and sod on both run-off and erosion is much greater than that of wheat.[4]

Erosion is not so serious in the prairie province as in other parts of the state, where the country is more rolling. However, since every acre of the land is valuable and grain farming is the chief type of land utilization, erosion, even in its earliest stages, is regarded as a serious menace.

Drainage

Illinois belongs to two great drainage regions: the Lake Michigan Basin and the Mississippi River Basin. The prairie province lies entirely in the Mississippi Basin; the low water parting, separating the streams which flow to the lake and those whose waters eventually reach the Mississippi, lies beyond the northeastern boundary of this area.

There are seven drainage basins in the prairie province; four of these are finally drained to the Illinois, two to the Wabash, and one directly to the Mississippi. The area of each watershed is shown in the following tabulation:

Draining to the Illinois	*Square Miles*	*Percentage*
Illinois-Vermilion	1,290	
Mackinaw	1,120	
Sangamon	2,340	
Salt Creek (Sangamon)	1,870	
Iroquois	1,000	
Total, Illinois	7,620	45
Draining to the Wabash		
Wabash-Vermilion	1,250	
Embarrass	2,260	
Total, Wabash	3,510	20
Draining to the Mississippi		
Kaskaskia	5,670	35
Total	16,800	100

In spite of its level topography, Champaign County is the most important hydrographic center of the prairie province. Four important rivers have their sources here; they are the Kaskaskia, the Sangamon, the Embarrass, and the Salt Fork—a headstream of the Wabash-Vermilion.

[4] Miller, M. F., "Ten-Year Average of Erosion Measurements," pp. 29-34.

The Kaskaskia and the Embarrass rise in the ridges of the Champaign morainic system. The Salt Fork and the headstreams of the Sangamon rise in the outer ridge of the Bloomington morainic system; the latter crosses the intermorainal plain and cuts across the Champaign moraine at Mahomet. (See Fig. 10.)

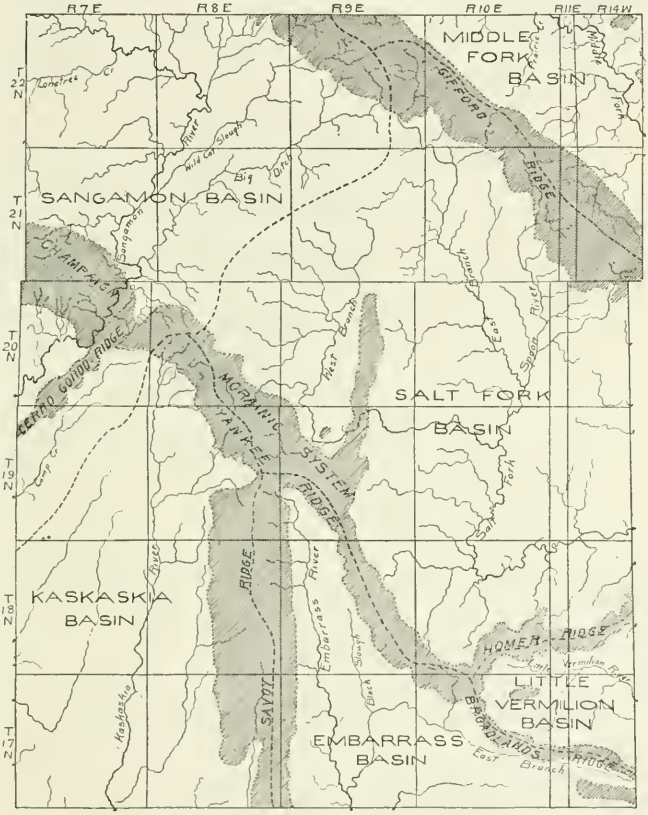

Fig. 10.—Map of Champaign County showing sources of the chief streams in the Champaign morainic system and the Gifford Ridge of the Bloomington morainic system. The divides are indicated by broken lines. (Courtesy of Illinois Agricultural Experiment Station.)

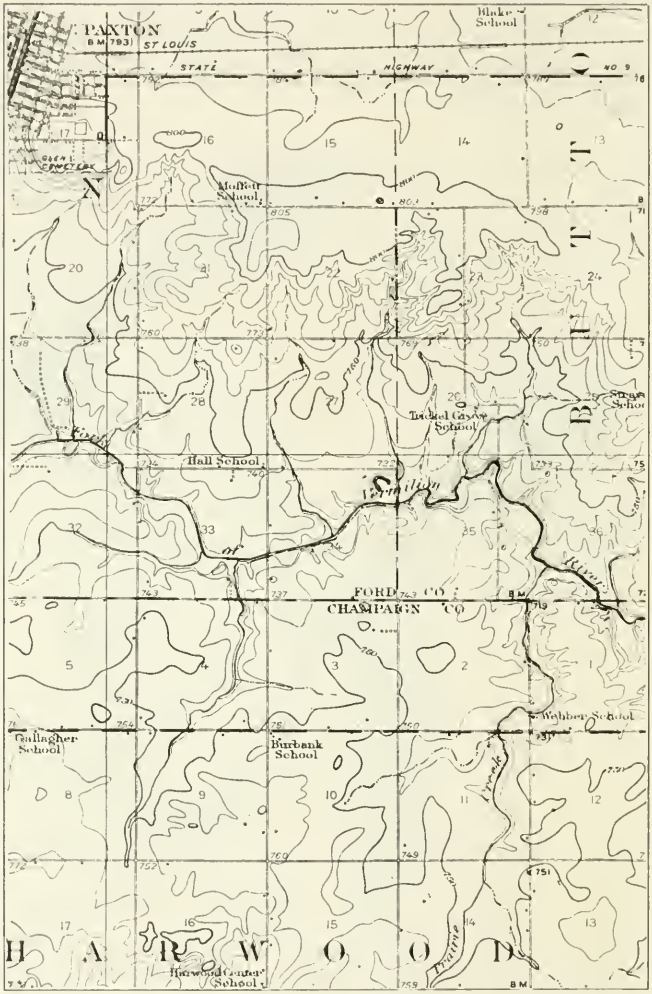

FIG. 11.—Topographic map of an area near Paxton, Illinois, typical of the youthful drainage system of the Wisconsin glaciation. Scale—1 inch equals 1.1 miles. Contour interval—10 feet. (U. S. Geological Survey.)

Many evidences of youthful drainage are to be seen in the area of Wisconsin glaciation. The streams, generally speaking, are post-Wisconsin, though some of them enter older valleys on leaving the Shelbyville moraine. In contrast to the topographically mature surface of the driftless areas of Illinois, the drainage here is in a youthful stage. The typical drainage pattern of the Wisconsin glaciated area is illustrated by the accompanying map of a district near Paxton, on the borders of Ford and Champaign counties (Fig. 11). (It is important to note that in this map the contour interval is 10 feet.) Even the Vermilion River has a very shallow valley. All of its tributaries which rise in the morainic ridge to

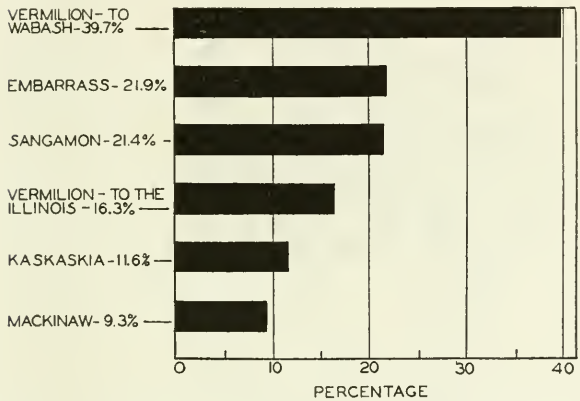

Fig. 12.—Graphs showing the amount of land with artificial drainage in the six chief river basins of the prairie province, expressed in percentage of the total area of each basin. (Data from Pickles and Leonard.)

the north are intermittent, and their valleys are very shallow. Poor drainage is evidenced in the swamps and small lakes. The divides are broad and indefinite, and it is apparent that the topography is in a younger stage than that of the part of the state covered by the Illinoian glaciation.

Glaciation has obliterated the old valleys, and sufficient time has not passed for the extensive development of new ones; hence a large part of the prairie province is imperfectly drained. Although the level nature of the province is a great advantage from many points of view, it is largely a disadvantage to agriculture in this area. Although the dangers from erosion here are less serious than on the rougher parts of the state, the difficulties with regard to drainage are much greater.

The percentage of the land artificially drained in the six chief river basins of the prairie province is shown in the accompanying graphs (Fig. 12). As would be expected, the largest percentage is in the basin of the Wabash-Vermilion. The land drained by this river is extremely flat, noticeably in Ford, Champaign, and Vermilion counties; and when

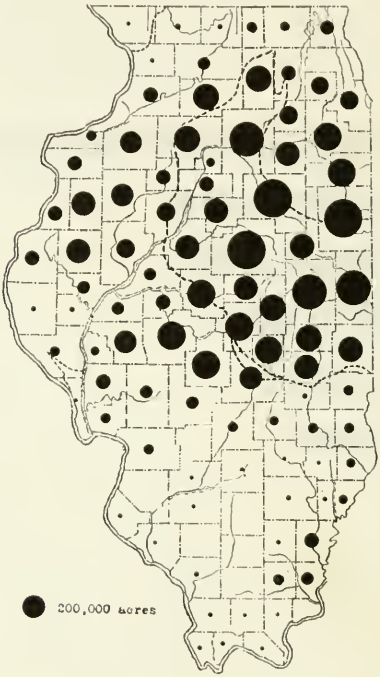

FIG. 13.—Map of Illinois showing amount of farm land with artificial drainage in each county in 1919. (Data from U. S. Census, 1920, vol. VII, pp. 448-450.)

drained, this is some of the most valuable land in the Corn Belt. Only a small percentage (9.3) of the Mackinaw Basin requires artificial drainage, as the topography is gently undulating (McLean, Tazewell, and Woodford Counties), and natural drainage is better developed than in the basin of the Wabash-Vermilion. It is evident that owing to the more adequate

natural drainage, the counties near the Illinois River have less need of artificial drainage than the counties farther east.

Of the operating drainage enterprises, 1,794,815 acres, or approximately one-half of the total acreage of all land so drained in the state (3,692,126 acres), is located in the prairie province.[5] (See Fig. 13.) Of the total miles of ditch and tile drainage, about three-fifths (3,281.3 miles) is found in this province. These figures again stress the fact that the difficulty of drainage is one of the most serious that the farmer in the province has to face. The land here, however, pays well for drainage because of its high content of nitrogen and other plant foods, which in better drained soils are often leached out to a great extent.

Ground Water

Glaciation has greatly lessened the difficulties of securing a water supply. Almost every high bank along a stream course shows one or more beds of sand and gravel. Wherever these beds lie below the level of the water table, they collect water in quantity. Wells less than 20 feet deep are abundant in the prairies. The discovery that the apparently waterless prairies held an easily accessible water supply was one of the greatest aids in their settlement. With the recent development of stock raising, especially in the region west of the Illinois River, the glacial gravel supplies of water have become insufficient, and dug wells are being supplanted by drilled wells which penetrate the underlying rocks for a more copious and constant supply.

In the prairie province the water supply is mainly from drift wells (Fig. 14). In the north and east of the province, and near the borders of the Chicago Region there are numerous rock wells, the reason being that the need of larger supplies is greater in the urban centers around Chicago. This has made it necessary to supplement the earlier wells in the sand and gravel of the drift.

There is great variation in the depth of the drift wells in this region. For example, at Mattoon, in the extreme south of the province, most of the wells are about 70 feet in depth, though many private dug wells are only 10 or 15 feet. At Paxton, in Ford County, the wells average about 140-150 feet in depth, while at Gibson City, only fifteen miles away, there are seven wells 55 feet deep. At Champaign, the wells of the University of Illinois and the Illinois Central Railroad Company strike a good water supply in a sand and gravel stratum at a depth of 140 feet.[6]

In Bureau County ninety-five "deep wells" are found to range in depth from 45 to 412 feet, and average 200 feet. The great majority of

[5] *Fourteenth Census of the U. S.*, vol. VII, pp. 451-459. 1920.
[6] Habermeyer, G. C., "Public Groundwater Supplies in Illinois," pp. 9, 122, 126, 394.

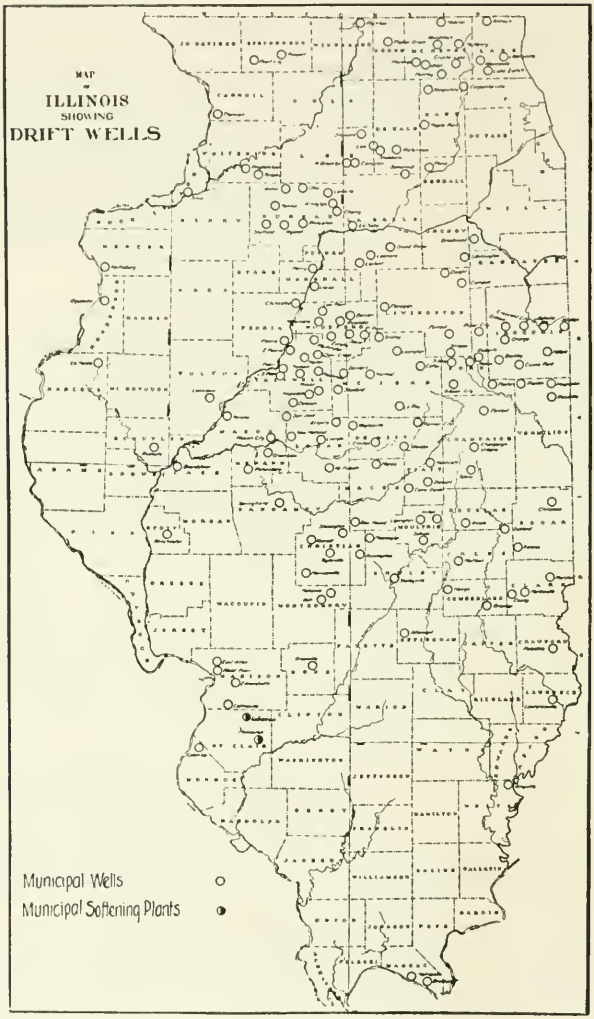

FIG. 14.—Map of Illinois showing locations of drift wells for public water supplies. (Courtesy of Illinois Water Survey.)

the wells in the county are much shallower.[7] This variation in the depth of the water table is due to many causes: the varying thickness of the drift, the different levels at which pronounced layers of porous sand and gravel are struck, and the nature of the seepage supply of water into the gravel beds.

Some knowledge of the preglacial drainage of the state has been acquired from various well borings. In the prairie province, however, where most of the wells are comparatively shallow, there are few data on the location of preglacial streams. Two interesting examples of such stream beds have been examined. About six miles southeast of Danville it appears from well borings that the Vermilion River crosses a preglacial valley, and the present valley bottom there spreads out to more than twice its normal width. In Moultrie County, south of Sullivan, according to recent well borings and field studies, the Kaskaskia River here follows a preglacial valley.[8]

[7] Leverett, Frank, *The Illinois Glacial Lobe*, pp. 630-633.
[8] Personal communication from L. E. Workman, Illinois State Geological Survey.

CHAPTER IV

SOILS

Sources of Soil Material

The principal sources from which the soils of the prairie province are derived are the glacial drift and loess. It may be said with certainty that, from the standpoint of soil formation, the glacial epoch was of the greatest importance in the geological history of Illinois. The chief contribution made by glaciation is the almost level surface over a large part of the province. The soils may also be considered especially favored for several reasons, among which are the following:

(1) Glaciation has greatly increased the thickness of the mantle rock. Over most of the prairie province the drift exceeds 150 feet in thickness.

(2) The soil formed by the weathering of the drift differs markedly from that formed by the weathering of the bedrock, in that it contains more soluble mineral matter, including the most valuable plant foods. In the older drift sheets the loss by leaching is greater than in the younger, and the productivity of the soil is correspondingly reduced. The soils of the prairie province, being formed from the youngest till sheets, and having a fairly level surface, have lost comparatively little plant food through leaching. Since glacial till is derived from many different kinds of rocks, it contains a great variety of mineral constituents, and practically all the elements for the growth of vegetation are present.

As previously stated, one of the chief drawbacks which glaciation has fixed upon this region is that of imperfect drainage. In most cases, however, the land which has required artificial drainage takes on a high value with the introduction of ditch and tile. Ford and Iroquois are counties in which originally there was much marsh land; this has now been drained and gives excellent crop returns.

The glacial till is covered by deposits of fine wind-blown material called loess, varying in thickness from a few inches to several feet. Loess is usually light buff in color, and is believed to have been derived from finely ground rock waste, originally spread out in the stream valleys and bottom lands flooded by water from the melting glacier. This light material was subsequently whipped up from the outwash flats by the wind and carried over the uplands.

The loess differs from the glacial till upon which it rests in being comparatively free from pebbles and bowlders. In some cases a few pebbles are present, but most of them are found at a depth of not less

than four or five feet. No doubt the loess was formerly more widespread than is now the case, as it has been stripped away from many localities by erosion. It is more porous than the drift; hence it is leached much more deeply than is drift soil of the same age. Shells of land snails (gastropods) are common in loess. It is usually calcareous, concretions of lime being common in many places. Carbonates occur at a depth of 30-40 inches in the drift soil, while in the loess no effervescence with acid occurs until a depth of 5-6 feet is reached.[1]

The deposits increase in thickness from east to west in this region. In Woodford, Tazewell, Marshall, Putnam, De Witt, and Macon counties, the mantle is considerably thicker on the west than on the east side, and there is a close relation between the width of the bottom land along the Illinois River and the depth and extent of the loess on the adjacent upland. In the west of Woodford County it is 11 feet thick, and on the western borders of the other counties mentioned it varies in thickness from 8 to 11 feet. The deposits are much thinner in the eastern counties; Ford, Vermilion, Piatt, and Champaign have a thin covering, seldom exceeding 3 feet in the rolling areas,[2] and often being entirely absent. In other words, the loess deposits are poorly developed in this region as compared with the greater thickness in the Mississippi valley and the western part of the state; they are, however, of great importance in their influence on agriculture.

Soil Development and Composition

The characteristics of a soil which are produced by the weathering process determine its properties to a large extent. For instance, the formation of a clay pan makes the soil both wet and droughty. Crops planted on such soils develop a shallow rooting system in the wet spring and then are likely to suffer from lack of moisture during the ripening period.[3]

When first deposited, the general composition of the soil material was fairly uniform throughout, but as time passed various weathering agencies formed soil out of the parent material by some or all of the following processes: the leaching of certain elements, the accumulation of others; the chemical reduction of certain compounds, the oxidation of others; the translocation of the finer soil particles, and the arrangement of them into zones, or "horizons"; the accumulation of organic matter from the growth and decay of vegetable material. One of the pronounced

[1] *Ill. Agr. Exp. Sta. Soil Report* 36.
[2] *Ill. Agr. Exp. Sta. Soil Reports* 14, 18, 36, 45, and unbound material on Ford and Piatt counties.
[3] Norton, E. A., *et al.*, "Considerations in Evaluating Illinois Farm Lands," p. 11.

characteristics observed in most soils is that they are composed of more or less distinct strata, or horizons.

The development of horizons in a soil is an indication of its age. Since the upland prairie of this region has been occupied, probably continuously, by grass vegetation, relatively large amounts of organic matter have accumulated, resulting in the formation of productive, dark-colored soils. These soils are relatively young, or immature, and therefore have not developed horizons as have the more mature soils in the southern part of the state which have been subject to a much longer period of weathering.[4]

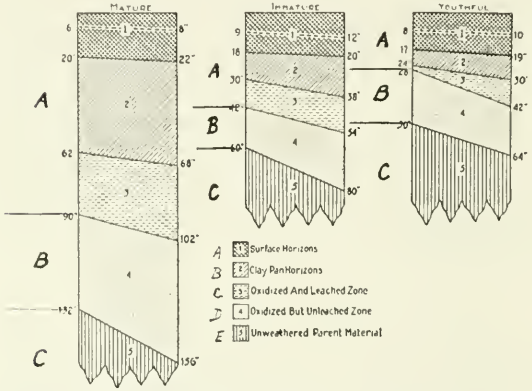

FIG. 15.—Diagrams showing arrangement of horizons in profiles of soils of different ages in Illinois: *mature*, as in southern Illinois; *immature*, as in the prairie province, where the several horizons are less sharply differentiated; and *youthful*, as in northeastern Illinois, where they are still more difficult to distinguish. Zones 1, 2, and 3 correspond to *horizon A*, the layer of eluviation; zone 4 corresponds to *horizon B*, the layer of illuviation; and zone 5 is the same as *horizon C*, the layer of parent material. (From E. A. Norton, *et al.*) (Courtesy of Illinois Agricultural Experiment Station.)

In a mature soil there are usually three distinct horizons designated as *A*, *B*, and *C*. *Horizon A* is the uppermost of the three. Under the conditions of a humid temperate climate, it represents the layer of extraction, or eluviation; that is to say, material in solution has passed out of this zone through the processes of weathering. *Horizon B* represents the layer of concentration, or illuviation, which is the layer developed as a result of the accumulation of material through the downward movement

[4] *Ill. Agr. Exp. Sta. Soil Report* 43, p. 5.

of water from the upper layer. *Horizon C* is the third layer, in which the material has been less affected by the weathering processes. This is the parent material from which the horizons above it have been weathered.[5]

The fact that the soils of the prairie province are immature is a distinct advantage from the point of view of agriculture. For these soils with their undeveloped horizons are less leached of the essential foods than are the mature soils. Consequently, if scientifically cultivated, the soils of the prairie province should retain their fertility for a longer period of time than the mature soils of southern Illinois. As indicated in Fig. 15, the unleached zone containing accumulated plant food, is at a much greater depth in the mature profile of southern Illinois than in the immature profile of the prairie province; that is, the mature soils are leached to a depth of 90-100 inches, whereas the immature soils are leached to a depth of only 42-54 inches.

Classification of Soils

A comprehensive classification of the soils of the United States, based on the work of Glinka[6] and Marbut,[7] has been worked out by Wolfanger[8] (Fig. 16). In this classification climate is the dominant factor, but the lime content, color of the soils, and type of natural vegetation are also important. There is significance in the place held by the soils of the prairie province in this classification.

I. Lime accumulating soils (grass soils).
  A. Desert or grayerths.
  B. Semi-arid or chestnuterths.
  C. Subhumid.
    1. Chernozems or blackerths (medium grass cover).
    2. Prairyerths-brown (heavy grass cover).
II. Non-lime-accumulating soils (forest soils).
  A. Cool-humid (coniferous forest cover) podsols.
  B. Cool-humid (deciduous forest cover) gray brownerths.
  C. Warm-humid (mixed forest cover) red-and-yellowerths.
  D. Hot-humid (tropical forest cover) laterites.

Between the semi-arid and the humid groups lie the subhumid soils, including the chernozems and the prairyerths which form a transition zone between the pedocals (lime-accumulating soils) and the pedalfers (non-lime accumulating soils). These two belts of subhumid soils represent the great grain regions of the United states. Their main characteristics are dark color, perfect structure, and fertility. The chernozems tend to be semi-arid, but the prairyerths merge into the humid soils.

[5] *Ibid.*, p. 20.
[6] Glinka, D. K., *Die Typen der Bodenkunden.*
[7] Marbut, C. F., *A Scheme for Soil Classification.*
[8] Wolfanger, L. A., "Major Soil Groups and Some of their Geographic Implications," pp. 94-114.

The prairyerths form a triangular-shaped area, about which the forest soils form two sides, while the chernozems, or blackerths, with a lower rainfall, form the third side of the triangle. This triangle was originally covered with long prairie grass, and the fact that it was not forest has yet to be clearly explained. These soils, like the chernozems, are developed chiefly on smooth plains topography. The rainfall, however, is 50 to 100 per cent higher. The crop production is heavy and usually certain. The area of distribution of the prairyerths roughly coincides with the western two-thirds of the Corn Belt. Although these soils are not

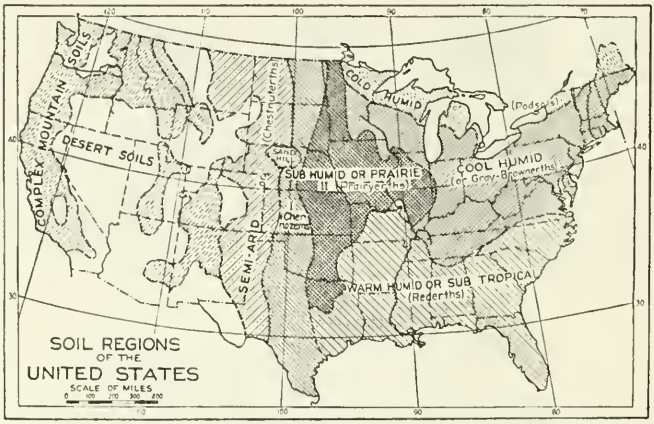

FIG. 16.—Map of the United States showing major soil divisions. (From Wolfanger, 1930.)

as well supplied with lime as the chernozems, they are better suited for general agriculture in having a sufficiency of rain. The prairyerths are dark-brown, and their nitrogen content is high, and they are not as markedly leached as the forest soils which form their eastern boundary. Eluviation and chemical transfer of material have been unimportant.

As has been noted, the Wisconsin glacial drift and the post-glacial loessial deposits constitute the parent material from which the soils, as we know them today, have been developed by weathering. According to the topography and natural vegetation, these glacial and loessial soils may be divided into four large groups: (a) upland prairie soils, (b) upland timber soils, (c) terrace soils, and (d) swamp and bottom-land soils.

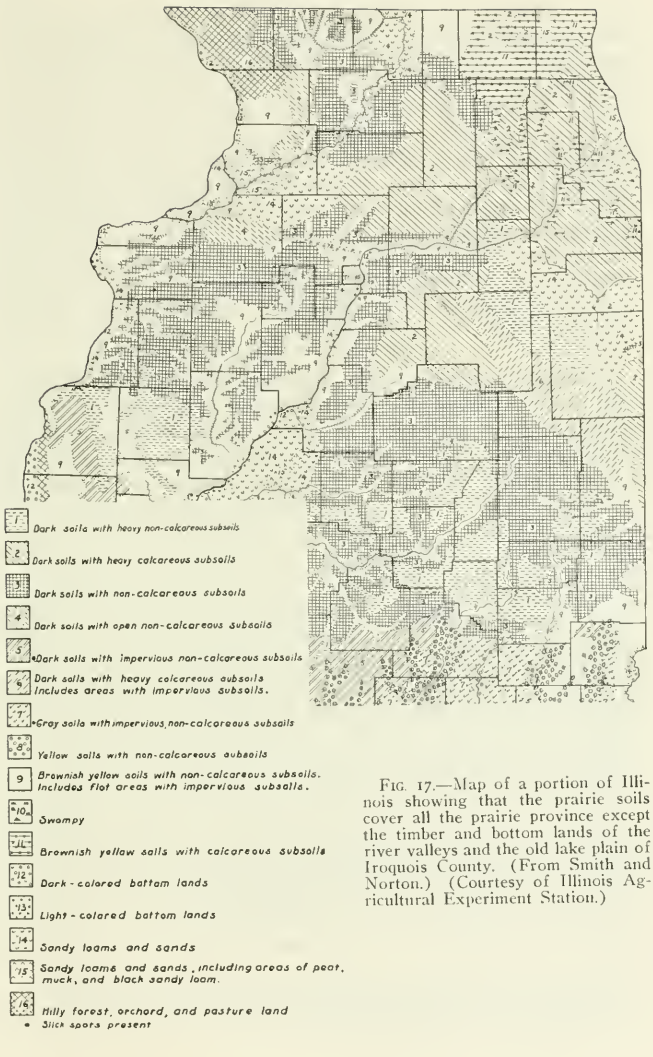
1 Dark soils with heavy non-calcareous subsoils
2 Dark soils with heavy calcareous subsoils
3 Dark soils with non-calcareous subsoils
4 Dark soils with open non-calcareous subsoils
5 *Dark soils with impervious non-calcareous subsoils
6 Dark soils with heavy calcareous subsoils Includes areas with impervious subsoils.
7 *Gray soils with impervious non-calcareous subsoils
8 Yellow soils with non-calcareous subsoils
9 Brownish yellow soils with non-calcareous subsoils. Includes flat areas with impervious subsoils.
10a Swampy
11 Brownish yellow soils with calcareous subsoils
12 Dark-colored bottom lands
13 Light-colored bottom lands
14 Sandy loams and sands
15 Sandy loams and sands, including areas of peat, muck, and black sandy loam.
16 Hilly forest, orchard, and pasture land
* Slick spots present

FIG. 17.—Map of a portion of Illinois showing that the prairie soils cover all the prairie province except the timber and bottom lands of the river valleys and the old lake plain of Iroquois County. (From Smith and Norton.) (Courtesy of Illinois Agricultural Experiment Station.)

The soils of the prairie province belong mainly to the first two groups. (See Fig. 17.) The terrace soils include bench lands and second bottoms formed by deposits from flooded streams overloaded with sediment, perhaps at the time of the melting of the ice. Iroquois County has the only large area of terrace soil; this region was the floor of an old lake, and it occupies 15 per cent of the area of the county, or about 2 per cent of the total area of the province. There is only a small amount of swamp and bottom-land soil in the prairie province—about 4 per cent of the total—and it is found chiefly in the flood plains of the Wabash-Vermilion, Sangamon, and Embarrass rivers.[9] Approximately 75 per cent of the prairie province is covered with upland prairie soil, and 14 per cent with upland timber soil. The properties of these two groups will be outlined somewhat in detail, as they are of primary importance in the province.

Upland Prairie Soils

The upland prairie soils are dark-colored and rich in organic matter, the latter having been derived from the fibrous roots of the wild prairie grasses, which occupied this land for many centuries. The protection afforded by this mat of constantly decaying material was of importance in retarding the decay of the roots. From a sample of virgin bluestem sod, one of the commonest prairie grasses, it has been determined that an acre of this soil to a depth of 7 inches may contain as much as 13½ tons of roots.[10] The chief divisions of the upland prairie soils are: (1) brown silt loam, (2) black clay loam, (3) drab clay loam, and (4) brown-gray silt loam on tight clay.

Brown silt loam constitutes the most common prairie soil in the Wisconsin glaciation. It is called "the ordinary prairie soil" by farmers of the Corn Belt. This type occurs on undulating topography, chiefly morainal, but also on some intermorainal areas. It has good drainage and underdrainage. Though not strongly acid, it is improved by the application of limestone. The soil and subsoil (*Horizons A* and *B*) have a capacity to absorb and retain moisture from heavy rains, and later to deliver it to growing crops as needed. This type, however, becomes much less absorbent and retentive where the surface soil is deficient in humus.[11] Although brown silt loam is normally a prairie soil, in some limited areas forests have recently invaded it; but this forestation has not continued long enough to produce characteristic timber soils.

Black clay loam is the commonest type of soil on the very flat prairie lands of the Corn Belt. It is often called "black gumbo," because it is

[9] *Ill. Agr. Exp. Sta. Soil Report* 22, pp. 20-22; *Soil Report* 10, pp. 3, 38.
[10] *Ill. Agr. Exp. Sta. Soil Report* 44, p. 15.
[11] *Ill. Agr. Exp. Sta. Bul.* 123, p. 222.

rich in organic matter, clayey or sticky, and plastic. It is most abundant in the broad intermorainal tracts of the Wisconsin glaciation, where it represents the richest Illinois prairie land existing in large areas. Traces of acidity are sometimes found in the black clay loam, but the subsoil usually contains plenty of limestone. The first problem with this type of soil has always been drainage. In most cases this difficulty has been overcome by the digging of large open ditches and by the laying of drain tile. Most of this land has been brought under profitable cultivation during the last 25 or 30 years.[12] As organic matter is destroyed by cultivation and nitrification, and as limestone is removed by cropping and leaching, this soil becomes gradually poorer in physical condition and harder to work. Organic matter should be maintained by turning under manure or crop residues, and ground limestone should be applied to keep the soil sweet. The difficulty in working clay soils is in proportion to their deficiency in organic matter.[13]

Of the other subdivisions of the upland prairie soils, the drab clay loam somewhat resembles the black clay loam in being poorly drained, but it is lighter in color and has a much lower organic content. Brown-gray silt loam on tight clay is a poor soil, being wet, difficult to drain, low in organic matter, and decidedly acid. This soil is not suitable for corn.[14]

Upland Timber Soils

The upland timber soils are usually characterized by a yellow or yellowish-gray color, which is due to their low organic content. This lack of organic matter has been caused by the long-continued growth of forest trees. As the forest invaded the prairies the following effects were produced: the shading of the trees prevented the growth of grasses, the roots of which were mainly responsible for the large amount of organic matter in the prairie soils; and the trees themselves added very little organic matter to the soil, for the leaves and branches either decayed or were destroyed by forest fires. The two chief subdivisions of the upland timber soils are: (1) yellow-gray silt loam, and (2) yellow silt loam.

Yellow-gray silt loam on rolling areas is the better drained but is subject to erosion and should be kept under a vegetative cover as much as possible. The more level areas require underdrainage and application of limestone to correct the acidity.[15]

[12] *Ibid.*, p. 234.
[13] *Ill. Agr. Exp. Sta. Soil Report* 18, p. 32.
[14] *Ibid.*, p. 35.
[15] *Ill Agr. Exp. Sta. Soil Report* 45, pp. 26-27.

Yellow silt loam, having a surface, or *A* horizon, that is generally thin and friable, should not be cultivated except where erosion can be properly controlled.

It is interesting to compare the two chief prairie soils and the upland timber soil with respect to the amount of plant food contained in each. The black clay loam of the flat prairie contains more of the essential elements than the other two soils. Because of the level topography, it is not leached to the same extent as the others; and for this reason, it requires no limestone. The timber soil has suffered more from leaching, because of the hilly nature of the topography, and also because it lacks the mat of grass covering which protects the prairie soil from leaching to a great extent.

TABLE 2. FERTILITY IN THE SOILS OF WISCONSIN GLACIATION
(Expressed as average pounds per acre out of a total of two million pounds of surface soil, 7 inches deep)

Type of Soil	Total Nitrogen	Total Phosphorus	Total Potassium	Limestone Required*
Brown Silt Loam of Undulating Prairie Land	5,050	1,190	36,250	Rarely
Black Clay Loam of Flat Prairie Land	7,840	2,030	35,140	None
Hilly or Rolling Timber Upland	1,890	870	32,720	1 to 2 tons

*In the column headed "Limestone Required" is given the amount of limestone (calcium carbonate) required to correct the acidity of the stratum named. The recommendations are based upon the average requirements to a depth of 20 inches, and upon average results from field experiments.

The productive capacity of practically all soils in good physical condition is measured by the available supplies of limestone and the three elements, phosphorus, potassium, and nitrogen, because they are required by all crops in very considerable quantities; while in most soils the supply of one or more of them is limited. If the supply of one of these elements is deficient, the yield of the crop is limited, even though all other factors essential to crop production are well provided.[16] The most productive soils contain in the surface 7 inches per acre, about 8,000 pounds of nitrogen, 2,000 pounds of phosphorus, and more than 30,000 pounds of potassium. The less gullied areas can be used for permanent pasture or orchards, while the remainder should be kept under permanent timber. Following an application of limestone, sweet clover or alfalfa can be grown on the gentler slopes.[17]

[16] *Ill. Agr. Exp. Sta. Bul.* 123, pp. 188, 196.
[17] *Ill. Agr. Exp. Sta. Soil Report* 45, p. 27.

CHAPTER V

CLIMATIC ELEMENTS IN RELATION TO CORN PRODUCTION

For climatological purposes, Illinois has been divided by the United States Weather Bureau into three sections, northern, central, and southern Illinois.[1] Latitude is the primary climatic factor in the state, as there is little in the physical characteristics to affect its climate. The whole state lies within the principal storm tracks that cross the country from west to east, and as a consequence there are marked and frequent weather changes, especially in winter. About three-fourths of the prairie province is in central Illinois, and the remaining one-fourth is in northern Illinois. The winters of the province are not as cold as those in the extreme northern counties of the state. During the warm periods of summer the temperature ranges as high as in the southern counties, but there is more relief resulting from intervening cool periods. As regards rainfall, the prairie province, with an average annual precipitation of 36.04 inches, holds an intermediate position between the northern district with 33.12 inches, and the southern district with 41.41 inches.[2]

From subsequent paragraphs it will be seen that this province has the humid continental type of climate; that is, it has greater extremes of temperature than are found in the same latitudes nearer the oceans, its rainfall is moderate, and its maximum precipitation is in the six months, April-September. These conditions have helped to make this part of Illinois one of the most important corn-producing regions of the world, and for this reason climatic conditions will be considered, to some extent, in relation to this crop.

The region of most intensive corn cultivation in the United States lies within a territory where the mean summer temperature is between 70 and 80° F., the average daily minimum temperature in summer is over 58° F., the average frostless season is more than 140 days, and the average annual precipitation is between 25 and 50 inches.[3] Rainfall, however, is the most important weather factor in connection with the corn crop.

The moisture requirements of corn vary at different periods of growth. The amount of water used increases gradually until the maximum leaf area has been made. This brings the maximum water require-

[1] Section 64, Northern Illinois; 65, Central Illinois; 66, Southern Illinois.
[2] *Summary of Climatological Data for the United States*, Sections 64-66, 1920.
[3] Smith, J. W., *Agricultural Meteorology*, p. 145.

ments when the corn is tasseling and earing. Tasseling time in the prairie province comes in July, and the critical period, when rain is most essential, is from the middle of July to the middle of August; the most important calendar month, however, is July. Corn should receive an average of at least 2.5 inches of rainfall during each of the months of its growth.

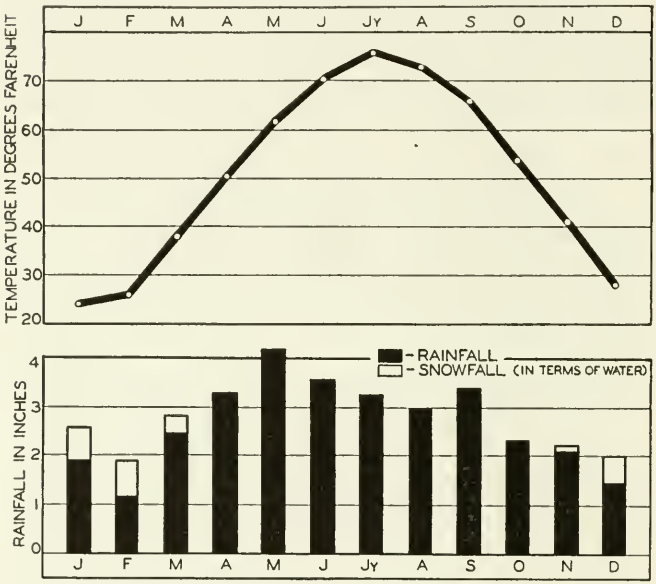

FIG. 18.—Graphs of average temperature and precipitation for six stations in the prairie province—Sycamore, Pontiac, Ottawa, Bloomington, Decatur, and Paris—the record for each station covering more than 20 years. (Data from *Summary of Climatological Data for the United States*, Sections 64-66.)

From Fig. 18 it will be seen that the rainfall is 3 inches or over for each of the months of the growing period. The effects of rainfall during May, June, and July upon corn yields are shown by the following records kept on the old corn plot at the University of Illinois:

Summer Rainfall	*Bushels per Acre*	*Years Averaged*
Less than 7 inches	25.3	8
Between 7 and 10 inches	32.4	9
Over 10 inches	39.8	11

When the rainfall was less than 2 inches per month the yield was reduced to 24.4 bushels per acre, and when it was over 13 inches in the three months the yield was 45.9 bushels. It is evident from this that a month during which there is less than 2 inches of rainfall may be regarded by the corn grower as a dry month.[4] Fig. 19 shows the relation between the corn yields and the rainfall for the month of July, over a period of 20 years in Illinois. The two curves are closely correlated, but there are some marked exceptions. It is evident that while the July rainfall is very important, it is not the only controlling factor. The temperature must be considered, also the rainfall in August, and to some extent that of June. Though the rainfall curve for 1906 shows a marked decline from the previous year, the corn yield curve does not follow it, because the August rainfall for that year was far above the normal and helped to counteract the effect of the dry July. In 1919 the heavy June rainfall did the same. In 1915 the July rainfall was too heavy for the best yields.

The comparative distribution of the seasonal rainfall in the several parts of Illinois is shown in Table 3, where the precipitation in each season is expressed in inches and in percentage of the total precipitation for the year. The increase in the winter is marked, from 5.44 inches in the northern part of the state to 10.66 inches in the most southerly counties. The higher summer percentages, especially in the central and northern districts, are important because this increase is a requirement for the best corn yields, such as are obtained in the prairie province.

TABLE 3.—SEASONAL RAINFALL IN ILLINOIS*

District	Winter		Spring		Summer		Autumn	
	In.	Perct.	In.	Perct.	In.	Perct.	In.	Perct.
Extreme Northern (6 northern counties)	5.44	16.0	9.34	27.4	11.22	33.0	7.99	23.6
Central Northern	5.80	16.8	9.61	27.9	10.75	31.6	8.11	23.7
Central	6.82	18.0	10.43	27.9	11.04	30.7	8.60	23.4
Central Southern	8.80	21.2	11.75	28.3	11.75	28.3	9.18	22.2
Extreme Southern (6 most southerly counties)	10.66	24.8	12.38	28.5	10.70	24.7	9.54	22.0

*From Mosier, J. G., "The Climate of Illinois," p. 22.

The winter precipitation in the form of snow plays a very important part in crop production. Its greatest value in humid regions is not the amount of moisture it supplies to the soil, but the protection it furnishes from temperature extremes. Being a poor conductor of heat, it affords protection to the crops that carry over in the ground during the winter, such as alfalfa, clover, and wheat. Snow prevents the alternate freez-

[4]Smith, J. W., *op. cit.*, pp. 150-151.

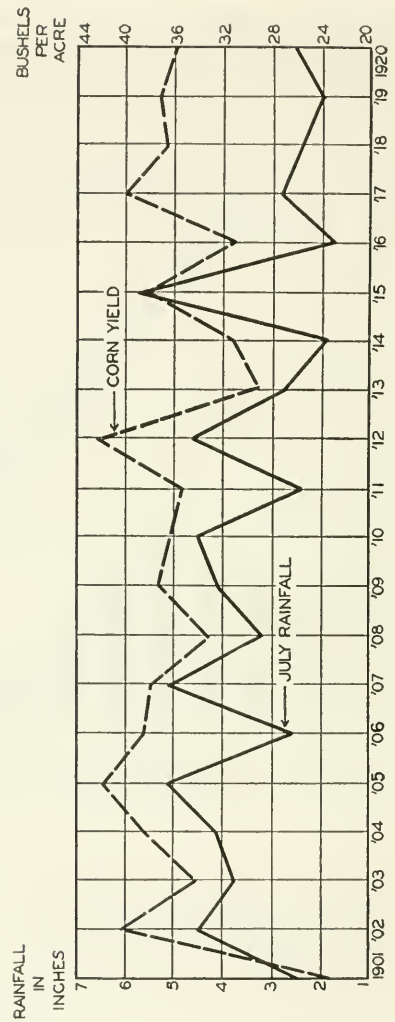

FIG. 19.—Graphs showing correlation of July rainfall and corn yields in Illinois, 1901-1920. (Data from U. S. Dept. Agr. Yearbooks and Climatic Summaries.)

ing and thawing which injures the crops. Open winters are very damaging, especially where the soil is not well drained. Repeated freezings cause the plants to be heaved out of the ground. If the soil is well drained the expansion of freezing will be taken care of largely within the pore space itself, and the soil does not grip the plant with sufficient firmness to loosen the deeper roots.

From the map (Fig. 20) it will be seen that the average annual snowfall of the prairie province is about 25-30 inches. Most of the snow falls in the months of December, January, February, and March. The precipitation in the form of snow is equivalent to 3.52 inches of water, or approximately one-tenth of the total precipitation.

The average monthly temperature of the prairie province is shown in Fig. 18. The average annual temperature is 50.7° F., while that of the extreme north is 47.2° and the extreme south is 57.9°. It should be noted that in the three months, June, July, and August, during which the corn crop is maturing, the temperature is over 70°. The average annual range in this province is about 109°, as against 115° in the extreme north and 103° in the extreme south.[5] The first vital function of plants which is influenced by temperature is that of germination. Oats, wheat, and rye will germinate slowly at temperatures between 32° and 40°, though higher temperatures are best. Corn requires a high temperature for quick germination. The zero point for the growth of corn is 49° F. In a test by Haberlandt (see Table 4), eleven days at 51° F. were required for the sprout to show, while at 65° only three days were required. Rapid germination lessens the danger from seed-destroying bacteria and fungi.

TABLE 4.—DAYS REQUIRED FOR GERMINATION OF SEED (RADICLE TO APPEAR) AT VARIOUS SOIL TEMPERATURES*

Seed	40° F.	51° F.	60° F.	65° F.
Rye	4	2 1/2	1	1
Wheat	6	3	2	1 3/4
Oats	7	3 3/4	2 1/4	2
Alfalfa	6	3 3/4	2 3/4	2
Corn	..	11 1/4	3 3/4	3

*From Mosier, J. G., "The Climate of Illinois," p. 24.

For the production of crops a certain number of hours in which the temperature is above the "zero point of growth" is necessary. These are known as "degree-hours" and are ascertained by multiplying the number of hours during which the temperature is above the zero point of growth by the number of degrees the average temperature is above that point.

[5] *Ill. Agr. Exp. Sta. Bul.* 86, pp. 65-66.

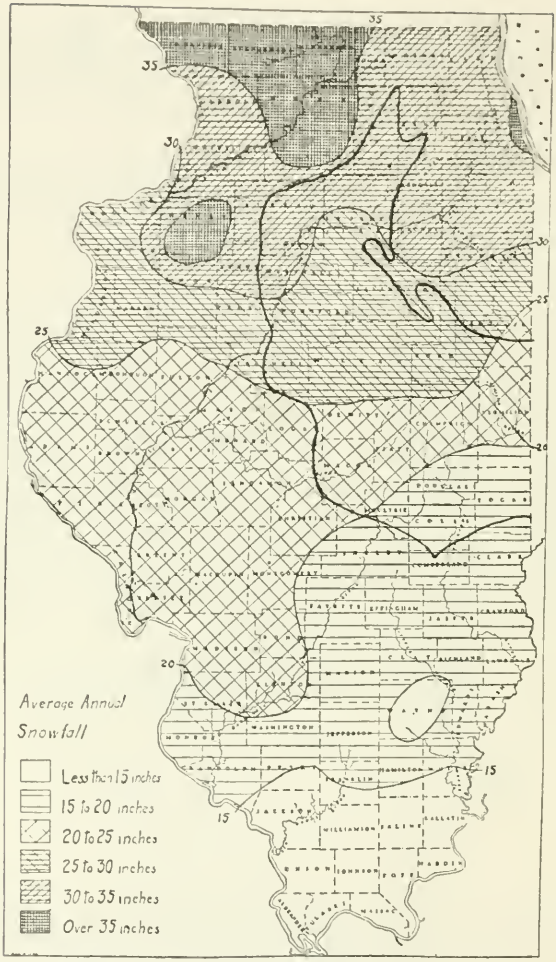

FIG. 20.—Map of Illinois showing average annual snowfall in Illinois. The average for the state is 24.7 inches. (From Mosier, 1918.)

Assuming that corn can make no growth below 49° F., and that it is planted on May 20th and continues to grow until September 15th, then the number of degree-hours of the growing season within the prairie province is 64,050.[6] Comparison with other districts, in this respect, is afforded by the following tabulation from records covering 40 years:

District	*Degree-Hours*
Extreme Northern Illinois	57,910
Prairie Province	64,050
Central Illinois	67,240
Extreme Southern Illinois	76,560

The records show that better yields are obtained when the number of degree-hours is slightly below the normal. The ten years with the highest number of degree-hours gave an average yield of 29.2 bushels, while the ten years with the lowest number gave a yield of 32.3 bushels. The relation of the number of degree-hours, mid-summer rainfall, and corn yields at the Urbana Experiment Station[7] is indicated by the following data:

Degree-Hours	*Average Bushels of Corn per Acre*	*Average Inches of Rainfall July and Augus*
Over 70,000	21.0 (for 4 years)	3.30
70,000–65,000	32.6 (for 5 years)	6.05
65,000–60,000	36.5 (for 8 years)	6.87
Below 60,000	36.6 (for 11 years)	6.82

These data seem to indicate that although a lower yield occurs during the years of higher temperature, the latter may be correlated with low rainfall, the consequent lack of moisture preventing the crop from utilizing the temperature possibilities.

TABLE 5.—AVERAGE DATES OF KILLING FROSTS IN ILLINOIS*

District	Last in Spring	First in Autumn	Days in Growing Season
Northern	April 29	October 6	160
Central	April 21	October 10	172
Southern	April 14	October 18	187

*From *Ill. Agr. Exp. Sta. Bul.* 86, p. 66.

The times of killing frosts in spring and autumn are very important as they determine the length of the growing season. Table 5 gives the

[6] Mosier, *op. cit.*, pp. 27-29.
[7] *Ibid.*, p. 30.

average date of the last killing frost in spring and the first killing frost in autumn for the three districts of the state. The growing season is nearly two weeks longer in the central section, and four weeks longer in the southern section, than in the northern section. The average length of the growing season of the prairie province is about 173 days (Fig. 4, p. 17).

The temperature of the soil is very important, not only in plant growth, but also in the biological activities taking place in the soil by which nitrification proceeds. The corn crop is more dependent on the temperature of the soil than on that of the air above it, as cold soil results in slow growth and late maturity. Soil temperature depends upon: (1) the moisture content of the ground, (2) the color, (3) the compactness, (4) the vegetative covering, and (5) the inclination of the surface to the sun's rays. It is difficult to say which of these factors is of greatest importance. The average monthly winter temperature of the soil to a depth of 1 to 3 inches is always higher than that of the air above it. From records kept over a period of 16 years at the Illinois Agricultural Experiment Station, it is evident that during most winters the soil freezes deeper than 12 inches. The 24-inch thermometer was not used until later, but records indicate that frost reaches only a little below the 12-inch depth.

In Table 6 the average temperature of soil at different depths is shown. From these data compared with the temperature of the air above, it can be seen that in the four winter months of November, December, January, and February, the soil is increasingly warmer than the air and that at a depth of 24 inches the average is considerably above freezing point when the average air temperature for those months is 5 or 6 degrees below freezing.

TABLE 6.—AVERAGE MONTHLY TEMPERATURE OF AIR AND SOIL AT DIFFERENT DEPTHS, ILLINOIS AGRICULTURAL EXPERIMENT STATION, URBANA
(Ten-year average)*

Depth in Inches	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Air	27.6	28.1	30.2	50.8	62.3	71.3	76.3	73.8	66.2	54.1	42.0	29.5
1	31.5	31.7	39.6	51.0	62.0	72.0	77.0	75.9	68.0	54.6	43.3	34.0
3	31.6	31.8	39.4	51.0	61.8	71.7	77.1	75.3	68.2	55.7	43.7	34.5
6	32.7	32.3	39.9	49.3	59.3	70.1	74.9	74.1	67.9	55.7	43.8	35.2
9	33.3	32.9	39.3	48.8	59.0	68.5	73.6	72.9	68.0	56.1	44.5	36.3
12	33.9	33.3	38.4	48.7	58.4	67.8	73.0	72.6	67.9	57.0	45.0	37.8
24	37.6	37.1	38.6	47.1	55.4	62.6	68.5	69.7	66.7	59.5	50.6	42.7
36	41.2	39.2	40.2	46.3	53.0	59.5	65.8	67.7	65.8	60.1	52.5	46.0

*From Mosier, J. G., "The Climate of Illinois," p. 46.

CHAPTER VI

NATURAL VEGETATION

The natural vegetation is the expression of environment; it is the integration of all climatic and soil factors, past as well as present, and therefore, if it can be clearly and distinctly indicated, often provides a better basis for a classification of environments than any other one factor or set of factors. The natural vegetation may serve a very concrete and practical purpose. As a new country becomes settled the original plant covering is usually replaced by agricultural crops, orchards, and pastures, and the suitability of the virgin land for various crops is usually indicated clearly by the native vegetation.

From a study of the soil reports of Illinois it is evident that the native vegetation has had a marked effect upon the composition of the soil. The organic matter of the forest soils ranges from about 25 to 50 per cent of the amount present in the adjoining prairie soils. As has been previously noted, this gives the latter a much darker color than the former, through the more complete decomposition of the remains of trees than of grasses. The greater amount of humus in the prairie soils increases their fertility over that of the forest soils; likewise, the matted nature of the grass roots checks the leaching of minerals such as calcium. This explains why yields on farms, formerly forested, decrease from year to year more rapidly than those on adjacent prairie soils, both of which have the same history, except that different native plants had grown upon them.[1] These differences in soil fertility are not restricted to forest and prairie, but there are important soil differences in areas covered by the two main types of grassland vegetation, namely, tall grass and short grass.

The grasslands of the north central states may be divided into the tall grass (prairie grassland), lying for the most part east of the 100th meridian, and the short grass which lies to the west of this line (Fig. 21). The dividing line between these two types marks rather sharp soil differences. It is correlated with the depth below the surface of the carbonate accumulation which marks the depth of the periodically moist layer of surface soil. Where the depth of moist soil is less than 2 feet, the short grass predominates; where it lies beyond this depth, the prairie type of grassland occurs.[2]

[1]Sampson, H. C., "An Ecological Survey of the Prairie Vegetation of Illinois," pp. 547, 572.

[2]Baker, O. E., *et al., Atlas of American Agriculture,* Part I, Sec. E., pp. 15, 16.

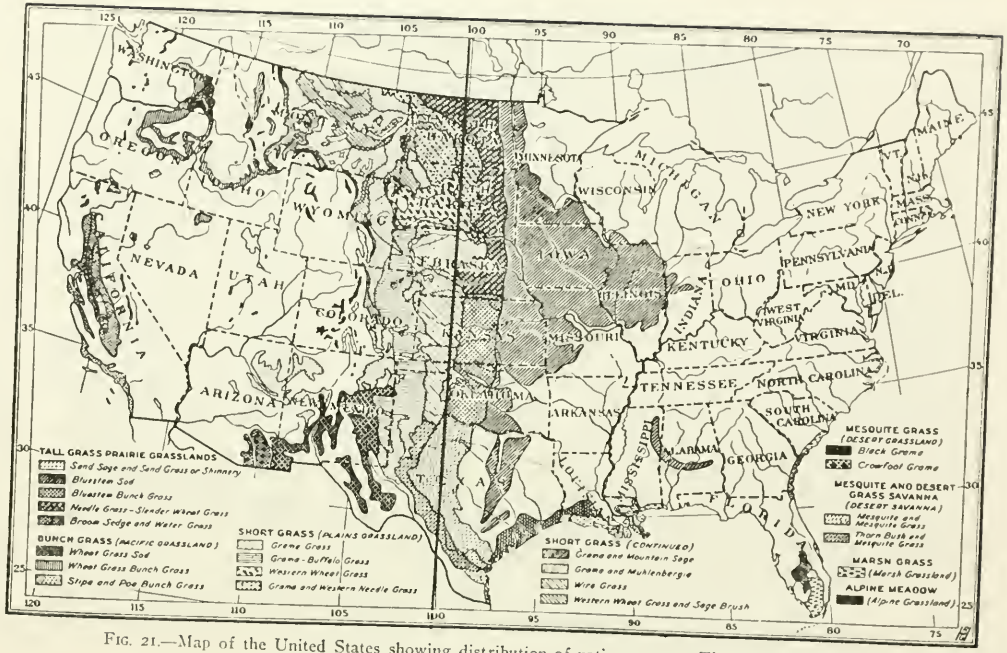

FIG. 21.—Map of the United States showing distribution of native grasses. The prairie province of Illinois is in the bluestem sod region. (From Baker, 1919)

The vegetation boundary between the tall and short grass is thus of great agricultural importance, since it separates the highly productive farm lands of the prairies from the less productive ranch lands of the plains. It is easy to see that the prairie province of Illinois, having such a small percentage of virgin forest, less than 16 per cent,[3] and a high percentage that was originally covered with tall grass, or bluestem sod, is especially favored from an agricultural point of view, though the shortage of timber is somewhat of a handicap.

The most prominent grass in the prairie region is the bluestem. The early explorers travelled for days through luxuriant fields of this grass. Birkbeck[4] in 1818 and Gerhard[5] in 1857 gave excellent descriptions of the prairie as it appeared in their day, before it was put under the plough. Much of the best agricultural land of the United States was formerly covered by this type of vegetation, and as is the case in the prairie province, the original grassland has been almost entirely replaced by cultivated crops. The remnants of the original upland prairie or tall grassland of the province today are limited to small tracts, fence rows, and railroad rights-of-way. Some larger tracts, however, are still intact outside the province, where bluestem tall grass is the predominant type of vegetation.

Causes of Prairie Vegetation

No other question in regard to the prairie has been so widely discussed as the causes of this type of vegetation. This is the result of many authors emphasizing local factors which do not apply to the prairie as a whole. For instance, prairie fires, grazing, and the character of the soil are factors that may affect the local distribution of the prairie and forest at their borders, but become insignificant in any attempt to explain the prairie as a whole. In some cases they have been reported as favorable to forest, in others as favorable to prairie. As a matter of fact prairie fires are an effect rather than a cause of the prairie.[6]

On the other hand, temperature, wind, humidity, rainfall, and topography were all important factors in causing the treelessness of the prairie. Taking the four climatic factors first, temperature, wind, and humidity may be dealt with as one factor, namely, evaporation. We have therefore only two climatic factors, evaporation and rainfall, to consider. Transeau has plotted the rainfall-evaporation ratios on the map of the United States (Fig. 22), by which the combined effects of temperature, wind, humidity, and rainfall upon the distribution of natural vegetation can be determined.

[3]Telford, C. J., "Third Report on a Forest Survey of Illinois," pp. 58, 63.
[4]*Notes on a Journey in America, Virginia to Illinois.*
[5]*Illinois as It Is*, pp. 256-287.
[6]Sampson, H. C., *op. cit.*, p. 574.

The region of the United States in which the ratio of rainfall to evaporation is between 60 and 80 per cent, as Transeau[7] points out, coincides with the prairie region. In general, where the ratio is less than 60 per cent, short grass or desert results; where it is more than 80 per cent, forests are found.

FIG. 22.—Map of the United States, east of the Rocky Mountains, showing ratio of rainfall to evaporation, expressed in percentage. The prairie province lies in the region with ratios between 60 and 80 per cent. (From Sampson after Transeau; courtesy of Illinois Natural History Survey.)

On this subject of the influence of climatic factors on prairie vegetation Gleason offers some interesting suggestions:

What were the conditions, climatic or of other nature at the close of the glacial epoch, which led to the invasion of prairie plants from the west, rather than forest plants from the southeast? Certain climatic conditions are more favorable to the growth of prairie than of forest, notably a low

[7]Transeau, E. N., "Forest Centers of Eastern America," pp. 875-889.

winter rainfall, and it is noteworthy that this type of rainfall is quite well developed in northern Illinois, and thence westward, but not in Indiana or in southern Illinois. . . . .

Prairie plants complete their cycle of development more rapidly than forest trees, and might enter the territory sooner on that account. But if trees had migrated to the north and west ever since the glacial period at a rate equal to their present movement, the present State of Illinois would undoubtedly, by this time, have been entirely covered with forests . . . .

The actual cause of the treelessness of the prairie . . . . is not to be found in any of the present conditions, but in the accumulated effects of centuries of arid climate in the southwest, from which direction the plants of our prairies immigrated.[8]

According to Transeau, the type of rainfall with regard to its regularity is effective in determining the type of vegetation. He states:

The precipitation types of the Short Grass Plains, the Tall Grass Prairie, and the adjoining Forest Regions show marked contrasts in monthly and annual variability.

On the High Plains the precipitation varies from 15-30 inches on the average, most of it falling during the growing season in the form of local showers. Consequently there are considerable monthly and annual variations which result in frequent droughts and inadequate soil moisture for the growth of large plants.

In the Forested Regions the precipitation varies from 30-45 inches, is more regularly distributed throughout the year and the annual variation is not large. Consequently there are neither frequent nor prolonged droughts.

In contrast to both these regions the Tall Grass Prairie region, with an average precipitation between 30-40 inches shows extremes both in monthly and annual variations. This results in great irregularity of available soil water, and occasional prolonged periods of drought. This is believed to be one of the important characteristics differentiating the prairie climate from that of the plains and the adjoining forested regions. This has also been an important factor in the development and maintenance of the unique prairie type of soil.[9]

Topography may influence the distribution of prairie through its effect on the climatic factors, as in the exposure or protection of slopes from prevailing winds or direct rays of the sun.

The water content of the soil is also important in this connection. The belts of forest are much narrower and the intervening prairie larger on the more youthful topography of the Wisconsin glaciation of the prairie province than on the older, better-drained Illinoian glaciation. This condition is a result partly of the difference in age of the drainage systems of the two regions. Forest associations do not easily establish themselves in marshy or waterlogged soils, as the long roots need air. The development of tall grasses which overgrow and overshade tree seedlings

[8]Gleason, H. A., "Some Unsolved Problems of the Prairies," pp. 266-268.

[9]Transeau, E. N., "Precipitation Types of the Prairies and Forested Regions of the Central States," pp. 44-45.

is another reason why forests have greater difficulty in invading poorly drained areas.

Topography also affects drainage conditions, and forests were more common on the morainic ridges and river bluffs than on the intervening level land. In many instances in the prairie province it seems likely that poor drainage prevented tree growth, as where swampy areas have been artificially drained, forest tree seedlings in several cases soon established themselves along the banks of the drainage ditches.

It is, therefore, apparent that climatic factors are important in determining the general boundaries of prairie distribution, while edaphic factors become more and more prominent toward the edges of the grassland. When a prairie association is once established, biotic factors and prairie fires are important in checking forest invasion.[10]

Any of the prairie associations may be invaded by forest under present conditions. Four methods of invasion are noted: (1) forest invasion accompanying erosion by streams, (2) growth of tree seedlings along forest borders where the grasses are checked by the shade of overhanging branches, (3) the occasional establishment of isolated seedlings farther out in the prairie, and (4) the growth of adventitious branch buds from the roots of certain trees extending short distances into the prairie. Many of the early writers claim that wherever the prairie was protected from annual fires the forest gradually encroached upon the grassland.[11]

Gerhard's volume, *Illinois as it is,* issued in 1857, includes a map by Dr. Frederick Brendel, of Peoria, showing the prairie, woodland, swamps, and bluffs. An adaptation of the map is given in Fig. 5 (p. 18). The wooded areas indicated there probably represent, with fair accuracy, the original forests of the state. About 30 per cent of the total area is shown as woodland, and approximately 70 per cent as prairie, including swampland.

The Brownfield Woods, about 3 miles northeast of Champaign, are of interest as one of the few remaining tracts of virgin forest in the prairie province, and as a sample of the type of forest which existed in the uplands of the Upper Wabash drainage basin. The tree associations vary somewhat in response to varying moisture conditions of the soil. The uplands and moderate slopes bear a rich variety in which hard maple is the commonest tree. Along the miniature bottoms elm predominates, but the type lines are not always sharply drawn, and elm may be commonly found in drier sites. Several of the largest oaks are over 300 years old.[12]

[10]Sampson, H. C., *op. cit.,* p. 525.
[11]*Ibid.,* p. 557.
[12]Telford, C. J., "Brownfield Woods."

CHAPTER VII

AGRICULTURE

Man's effort to adapt himself to his environment is reflected in his surroundings, and the result is the cultural landscape as seen in the dwellings, barns, fields, fences, roads, and towns. In the prairie province of Illinois the features of this landscape are very simple and obvious. The white farm house, the red out-buildings, the silo, the windmill, the slotted barn, and the grain elevator are all familiar sights. In September the waving cornfields are ready for the harvest, and timothy is showing among the stubble in the oat fields. Later in the fall the corn husker will be seen at work, the winter wheat begins to show, and the hogs or cattle are seen stripping the last of the corn stalks. That the prairie province is an agricultural region is obvious even to the casual observer, but the true significance of agriculture in this part of the state becomes clear only on closer study.

Value of Agricultural Products

Of the land area of the province, approximately 90 per cent is in farms, which is higher than the average for the state by 5 per cent. While 59 per cent of the state is in crop land, 69 per cent of the prairie province is utilized in this way. About 30 per cent of the population of the province is on farms, and this is twice the percentage for the state. It is evident that agriculture is the keynote of human activity in this region.

Of the total number of farms in Illinois, 21 per cent are located in the prairie province, but of all the manufacturing establishments in the state, only 8 per cent are found here.[1] These establishments are much smaller on the whole than those of the Chicago region. Agricultural products generally constitute the raw material, as in the preparation of corn products and the milling of wheat flour, though the manufacture of agricultural implements and the preparation of fertilizers are also important, as will be shown later. The province contributes approximately one-third of the value of all crops in the state, but only one-fourth of the value of livestock. Of the total value of agricultural products (crops and livestock) in the prairie province itself, livestock constitutes one-third and crops two-thirds.

[1] *Fourteenth Census of the United States*, 1920.

Conditions Favoring Crop Production

Three geographic factors, namely, climate, soil, and topography, have been instrumental in making the prairie province a part of one of the chief regions of the United States for the production of grain, primarily corn but also oats and wheat. In the Corn Belt as a whole, climate has been the limiting factor along the northern and western boundaries, while the southern and eastern boundaries are determined rather by soil and topography. All of the Corn Belt has been glaciated except the plains of central and western Nebraska and northern Kansas; consequently the soils are relatively youthful and unleached.[2] As has been shown, corn is very sensitive to the rainfall distribution, and the length and temperature of the growing season. All the optimum climatic conditions are present in the prairie province. As previously stated, 75 per cent of the soils of this region of the Wisconsin glaciation are upland prairie soils, mostly brown silt and black clay loams, some of the richest soils in the world.

Use of Farm Machinery

The extensive use of farm machinery, which is constantly becoming more efficient and essential to profitable grain production, has greatly increased the influence of topography in determining the utilization of the land. While hilly regions, as compared with level lands, in addition to the disadvantages of shallower and less fertile soils, now suffer from the further disadvantage of being poorly adapted to the use of modern farm machinery, the flat or gently rolling surface of the prairie province is well suited to the use of tractors and large machinery. Illinois ranks high among the states in number of tractors, with an average of 90 tractors per 100 square miles of farmland, but in the prairie province the average is 127, or 60 per cent more. The average is 87 in Wisconsin, 78 in Pennsylvania, 72 in Iowa, 70 in California, and 46 in Kansas.[3] In Illinois as a whole, 27 per cent of the farms have one or more tractors, while in the prairie province this is the case with 34 per cent of the farms.[4] Although the province represents less than one-quarter of the land area of the state, approximately one-third of the total value of farm implements and machinery of the state is in this region. These figures show conclusively that in this area there is extensive use of labor-saving machinery, making possible a large production of agricultural commodities per man.

[2] Baker, O. E., "Agricultural Regions of North America," *Econ. Geog.*, vol. 3, pp. 451-453.

[3] *U. S. Census of Agriculture*, 1925.

[4] Personal communication from A. J. Suratt, Illinois Farm Equipment Survey, Springfield, Ill., 1928.

Chief Crops of the Province

Of the four major crops grown in the prairie province, corn is the chief, more than one-half of the acreage being under this crop. Oats are next in importance, constituting practically one-third of the acreage, while hay and wheat account for about 9 and 8 per cent, respectively. The prairie province accounts for about 36 per cent of the total acreage of the Illinois corn crop, 42.6 per cent of the oats, 19.8 per cent of the wheat, and 14.4 per cent of the hay. (See Figs. 23-28.)

Although the physical conditions are fundamental in determining the crops in a region, there are economic factors which strengthen the influence of the physical factors. The best land tends to be utilized for the most valuable crop, and related to this tendency is the principle that the crop which is most limited by physical requirements will have first choice of the land, and it consequently demands a price which gives it an advantage over the other crops. In the prairie province corn is the crop which, so to speak, has the natural monopoly.

The different seasonal requirements of various crops, as regards labor, tend to diversify the agriculture of a region. In the southern part of the province wheat can be seeded in the fall after the corn crop has been removed, and harvested in summer after the corn cultivation is over; likewise, oats can be seeded before the corn is planted in spring. Therefore these small grain crops are grown although they may not pay as well as the corn crop. It is desirable to grow a combination of crops to equalize the labor requirements, but it is also very important to grow such a combination as will maintain soil fertility and keep it free from insect pests.[5]

Crop Rotation

The best rotations in this area include an intertilled or cultivated crop (corn) which provides for the killing of weeds and maintenance of the tilth; a small grain crop (wheat or oats) into which the grass or legume crop (timothy or clover) can be seeded. Since a rotation may vary in length from 3 to 6 years, emphasis should be placed on these three kinds of crops. Along the southern border of the prairie province winter wheat is the small grain crop rather than oats, for in these counties the corn can be removed from the ground in time to seed the wheat in the fall, whereas in the northern counties this cannot be so consistently done, and a spring sown crop, such as oats, is more generally grown. In some parts of the state, alfalfa, which is less dependent upon rainfall than timothy and clover, is replacing them to a considerable extent.

[5] Baker, O. E., *op. cit.*, vol. 2, 1926, pp. 459-493; vol. 3, 1927, pp. 447-465.

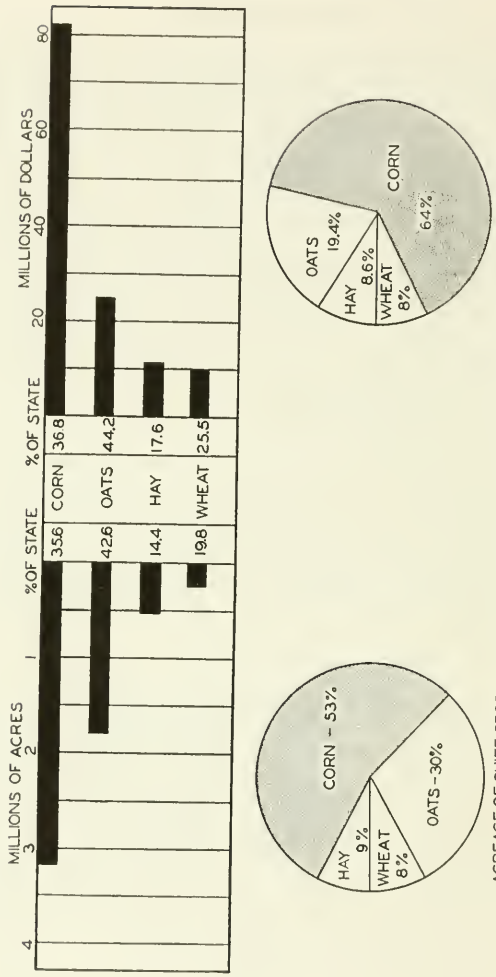

FIG. 23.—Graphs showing acreage and value of chief crops in the prairie province in 1925. (Data from U. S. Census of Agriculture, 1925.)

FIGS. 24-28.—Maps of Illinois showing acreage of principal field crops (each dot representing 1,000 acres) and swine distribution (each dot representing 1,000 hogs.) (From U. S. Census of Agriculture, 1925.)

Fig. 29 suggests how crops may be combined in the right proportions to use labor to advantage, which is an important factor in keeping the cost of production low. Of the legumes, soybeans and alfalfa interfere with the labor needed for the other crops more than clover does, but alfalfa is a more valuable hay crop than either clover or timothy.[6]

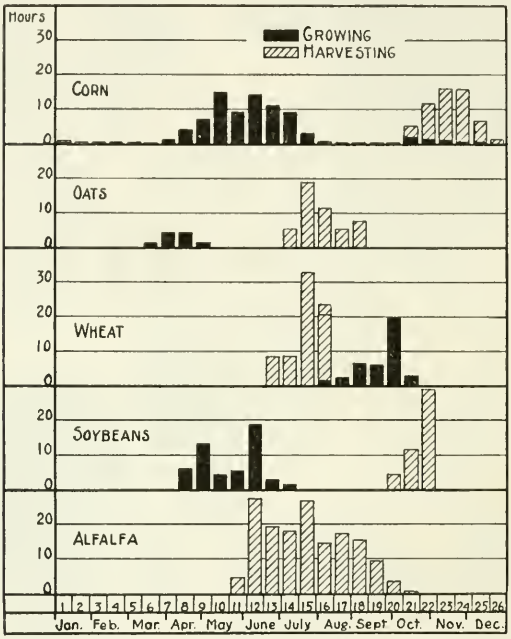
Hours
GROWING
HARVESTING
CORN
OATS
WHEAT
SOYBEANS
ALFALFA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Jan. Feb. Mar. Apr. May June July Aug. Sept Oct. Nov. Dec.

FIG. 29.—Graphs showing hours of man labor required to grow and harvest ten acres of each crop indicated, in Illinois, by two-week periods through the year. The graphs suggest possibilities of combining crops in the right proportions to use labor to advantage. (Courtesy of Illinois Agricultural Experiment Station.)

In the prairie province a legume should be grown at least one year in four or five, as a means of maintaining nitrogen and organic matter in the soil. It is possible to follow corn with an annual legume, such as soybeans, but a deeper rooting legume is sometimes desirable, such as sweet

[6]Case, H. C. M., *et al.*, "Organizing the Corn-Belt Farm for Profitable Production," pp. 267-298.

clover and alfalfa. These usually are also the most profitable legume crops. As alfalfa interferes materially with the labor requirements of other crops, it can be grown on a field not included in the main rotation, and red clover, though not such a deep rooting crop as sweet clover and alfalfa, can be profitably included in the rotation, either to be used as feed for livestock or ploughed under. In this way the nitrogen content of the soil is maintained. When the rotation is completed the alfalfa may be removed to another field.[7]

Rotations suggested by the University of Illinois Agricultural Experiment Station for Champaign and Piatt counties,[8] in the center of the prairie province, are as follows:

Four-Year Rotations

1. First Year—Corn
   Second Year—Oats (with clover)
   Third Year—Clover
   Fourth Year—Wheat (with sweet clover)
2. First Year—Corn
   Second Year—Corn
   Third Year—Oats (with clover)
   Fourth Year—Clover

Five-Year Rotation

First Year—Corn
Second Year—Corn
Third Year—Oats (with clover)
Fourth Year—Clover, or clover and grass
Fifth Year—Wheat (with sweet clover)

These rotations are built around corn, or corn and wheat or oats, as grain crops, with clover as the legume. With each of these rotations a large proportion of the land is devoted to highly profitable crops.

Use of Fertilizers

While crop rotation is a fundamental part of soil management, even good rotations cannot maintain crop production at a high level without the addition of either limestone or fertilizer, or both. In the first place, rotations which are most effective in maintaining soil fertility include legumes, which are sensitive to acidity, and this usually necessitates the use of limestone to sweeten the soil before the rotation can be established.

Of the elements of plant food, three (carbon, oxygen, and hydrogen) are secured from the air and water, and the others from the soil. Nitrogen, one of the elements obtained from the soil by all plants, can also be taken from the air by leguminous plants. The productivity of practically all soils in good physical condition is measured by the available supply of limestone, and of the three elements, nitrogen, phosphorus, and potassium. These four soil constituents are required by all crops in very considerable quantities, while in most soils the supply of one or more of them is limited. Table 7 shows the requirements of some of the common crops

[7] *Ill. Agr. Exp. Sta. Bul.* 329, 1929, p. 294.
[8] *Ill. Agr. Exp. Sta. Bul.* 277, p. 53.

of the prairie province with respect to important plant-food elements furnished by the soil. From the data given here, the amounts of these elements removed from an acre of land by a crop of given yield can easily be computed. It can also be seen how a deficiency of one of these elements of plant food may become a limiting factor of crop production. Table 8 gives the quantity of three of the chief plant-food elements contained in one ton of farm manure, rough feeds and bedding, and other fertilizer materials. Not much commercial fertilizer has, as yet, been

TABLE 7. PLANT-FOOD ELEMENTS IN COMMON FARM CROPS*

Produce		Nitrogen	Phosphorus	Sulfur	Potassium	Magnesium	Calcium	Iron
Kind	Amount							
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Wheat, grain	1 bu.	1.42	0.24	0.10	0.26	0.08	0.02	0.01
Wheat straw	1 ton	10.00	1.60	2.80	18.00	1.60	3.80	0.60
Corn, grain	1 bu.	1.00	0.17	0.08	0.19	0.07	0.01	0.01
Corn stover	1 ton	16.00	2.00	2.42	17.33	3.33	7.00	1.60
Corn cobs	1 ton	4.00	.....	.....	4.00	.....	.....	.....
Oats, grain	1 bu.	0.66	0.11	0.06	0.16	0.04	0.02	0.01
Oats straw	1 ton	12.40	2.00	4.14	20.80	2.80	6.00	1.12
Clover seed	1 bu.	1.75	0.50	.....	0.75	0.25	0.13	.....
Clover hay	1 ton	40.00	5.00	3.28	30.00	7.75	20.25	1.00
Soybean seed	1 bu.	3.22	0.39	0.27	1.26	0.15	0.14	.....
Soybean hay	1 ton	43.40	4.74	5.18	35.48	13.84	27.56	.....
Alfalfa	1 ton	52.08	4.76	5.96	16.64	8.00	22.26	.....

*These data are brought together from various sources. Some allowance must be made for the exactness of the figures because samples representing the same kind of crop or the same kind of material frequently exhibit considerable variation. (From Ill. Agr. Exp. Sta., Soil Report 45, p. 35.)

used on the fertile soils of the prairie province, but the amount in use in the state is increasing, especially near the Indiana line.[9] Less farm manure is used in the prairie province, primarily a grain-producing region, than in other parts of the state. Soil fertility is maintained largely by the application of ground limestone and by ploughing under leguminous crops, such as clover and alfalfa.

The importance of limestone for Illinois soils can scarcely be overestimated. It corrects acidity (the soils of the state are, in general, markedly acid), it establishes conditions required for some of the beneficial bacteria, and it accelerates nitrification. It promotes sanitation of the soil by inhibiting the growth of fungus diseases. Experience indicates that it modifies the physical structure of fine-textured soils, frequently to

[9]Personal communication from Professor C. M. Linsley, College of Agriculture, University of Illinois.

their improvement. Thus, working in one or more of these different ways, limestone becomes the key to the improvement of worn lands.[10]

Of the 925,000 tons of ground limestone used in the state in 1929, 18.1 per cent was used in the prairie province. In the state as a whole, 88 pounds are used on an average per acre, while in the counties of the prairie province the average is only 53 pounds per acre. That a smaller amount is used in this region may be due to the fact that this is primarily a grain region, so that there is not the same incentive to grow legumes for hay crops that there is in the livestock regions. The chief use of

TABLE 8.—PLANT-FOOD ELEMENTS IN MANURE, ROUGH FEEDS, AND FERTILIZERS*

Material	Pounds of plant food per ton of material		
	Nitrogen	Phosphorus	Potassium
Fresh farm manure	10	2	8
Corn stover	16	2	17
Oat straw	12	2	21
Wheat straw	10	2	18
Clover hay	40	5	30
Cowpea hay	43	5	33
Alfalfa hay	50	4	24
Sweet clover (water-free basis)†	80	8	28
Dried blood	280	...	...
Sodium nitrate	310	...	...
Ammonium sulfate	400	...	...
Raw bone meal	80	180	...
Steamed bone meal	20	250	...
Raw rock phosphate	...	250	...
Acid phosphate	...	125	...
Potassium chlorid	...	...	850
Potassium sulfate	...	...	850
Kainit	...	...	200
Wood ashes‡ (unleached)	...	10	100

*See footnote to Table 7.
†Young second-year growth ready to plow under as green manure.
‡Wood ashes also contains about 1,000 pounds of lime (calcium carbonate) per ton.

ground limestone is to sweeten the soil for legumes; for other crops are not so sensitive to acidity. About 740,000 tons were used in 1928, as against 925,000 tons in 1929, and 811,000 tons in 1930.

The nitrogen problem is one of foremost importance in the prairie province. There are four reasons for this: nitrogen is becoming increasingly deficient in most soils; its cost is almost prohibitive when purchased in the open market; it is removed from the soil in large amounts by crops; and it is very easily leached from the soil. A 50-bushel crop of corn requires about 75 pounds of nitrogen for its growth. Leguminous plants are able, with the aid of certain bacteria, to draw upon the inexhaustible supply of nitrogen in the air, utilizing it in their food require-

[10] *Ill. Agr. Exp. Sta. Soil Report* 44, p. 31.

ments. In this way legumes through the decay of their tissues add nitrogen to the soil which can then be assimilated by other crops.[11]

Farmers of the prairie province are using legumes more and more as green manure to supply nitrogen. In every county of the province there was an increase in the acreage under alfalfa from 1928 to 1929. In the state it increased from 102,000 acres in 1028 to 221,000 acres in 1929. State acreage of sweet clover also increased from 697,000 acres in 1928 to 748,000 acres in 1929.[12]

The amount of phosphorus in soils varies greatly, even in small areas. This essential element of plant life is slowly removed by cropping and has to be replaced either by natural means, such as overflow, as in river bottomlands, or by the addition of phosphate fertilizer. In the prairie province rock phosphate is applied directly to the soil. In 1930 one-half of the amount used in the state was applied to the soils in the province (17,392 tons out of 34,727 tons), and of the farmers using it in that year for the first time, 43 per cent were in the province. Most of the rock phosphate is obtained from the Mt. Pleasant quarry in Tennessee. The most common soils of the province, namely, the silt loams and clay loams, are well stocked with potassium. Peat soils, such as are found in Kankakee and parts of Iroquois counties, are deficient in this element, but generally speaking, there is little of this type of soil in the province.

Calcium and magnesium are also important soil constituents removed by cropping. The application of ordinary limestone replaces the calcium, while dolomitic limestone, which is so extensively quarried in northern Illinois, furnishes both calcium and magnesium in available form for use by plants. As will be shown later, most of the limestone-shipping quarries are located in the Pennsylvanian deposits around the edge of the Illinois coal basin. The most important of these are outside the prairie province, but local supplies are quarried in Clark and Vermilion counties. Much ground limestone is obtained from the St. Louis district and from the quarries of Cook County. From the latter region large quantities of ground limestone are sent to Chicago and its environs, but a considerable tonnage is shipped south to the prairie province, usually in the coal cars returning to the mines over the Illinois Central Railroad.[13] Good dolomitic limestone is also obtained from the quarries at Joliet.

The Corn Crop

Of the two great areas for the production of surplus corn in the United States, northeastern Illinois (within a radius of about 150 miles

[11] *Ill. Agr. Exp. Sta. Soil Report* 45, p. 40.
[12] Personal communication from Professor Linsley.
[13] Krey, F., and Lamar, J. E., "Limestone Resources of Illinois," pp. 98-99.

of Chicago) ships out most grain.[14] The system of farming here is somewhat different from that practised in other parts of the Corn Belt, the larger part of the grain being sold as grain and not in the form of livestock. In the prairie province 95 per cent of the corn is destined to be shipped as grain, leaving but a negligible amount to be cut for silage and fodder or "hogged off." In many districts the cost of transportation prevents the shipment of grain long distances, and the crops can be more economically disposed of by feeding them to animals and marketing them in the more concentrated form of livestock or livestock products. The ease, and consequently the comparative cheapness, with which roads and railroads have been constructed, and the nearness to Chicago, the greatest grain market of the United States, have made it more profitable for the farmers here to ship their grain direct to that city than to feed it to livestock. Chicago acts as a great magnet to grain, and the freight rates are especially favorable to farmers of the province.

Since 1920 Iowa has held first place in the production of corn, while Illinois is second. Corn accounts for 52 per cent of the value of all crops in Illinois and 44.1 per cent of the acreage cultivated in the state. In the prairie province the environmental conditions are highly favorable to large-scale production of this crop. In the north the separation of this grain-producing province from the dairy section is mainly due to climatic conditions, while in the south the boundary line is the border of the Wisconsin glaciation, below which the corn acreage and yield fall abruptly.

The amount of grain produced in any region is determined by the acreage planted and yield per acre. The acreage planted to corn is higher in the center of the prairie province than elsewhere in the state (Fig. 24). As has been shown, the physical and economic conditions, to a great extent account for this high acreage. The value of the corn crop in the province, as compared with that in the state, is shown in Fig. 23 (page 74).

With regard to the yield per acre, there is a marked difference between the dark-colored prairie soils of the Wisconsin glaciation and the light-colored timber soils south of the Shelbyville moraine. A five-year average for five representative counties north of the moraine (Putnam, Woodford, Vermilion, Bureau, and Champaign counties) was 30 bushels, while that of five representative counties south of the moraine (Franklin, Jasper, Crawford, Marion, and Cumberland counties) was 25 bushels. It is also interesting to note the difference in acre yields on the younger Wisconsin glaciation and on the older Illinoian drift, even in adjoining counties. In Coles County, on the former, the average yield for five years was 32.2 bushels per acre; and in Cumberland County, on the latter, it was 26 bushels per acre. The same is the case for the adjoining counties, Edgar

[14] *U. S. Dept. Agr. Year Book*, 1921, p. 199.

County on the Wisconsin and Clark County on the Illinoian glaciation, the respective yields being 30 and 28 bushels per acre.[15]

As has been shown, corn is the main cultivated, or intertilled, crop of this region. It gives a better immediate profit than any of the small grain crops. Corn supplies more calories of food per acre than any of our other great staples. Its value in this respect is almost double that of wheat, oats, or rye. Condensed as pork, the yield per acre is only about one-fifth, and as beef, about one-twenty-fifth, the calory value of corn (Fig. 30). On typical farms in Champaign and Piatt counties during the years 1921-26, the net profit per acre was $5.55 for corn (valued at 67

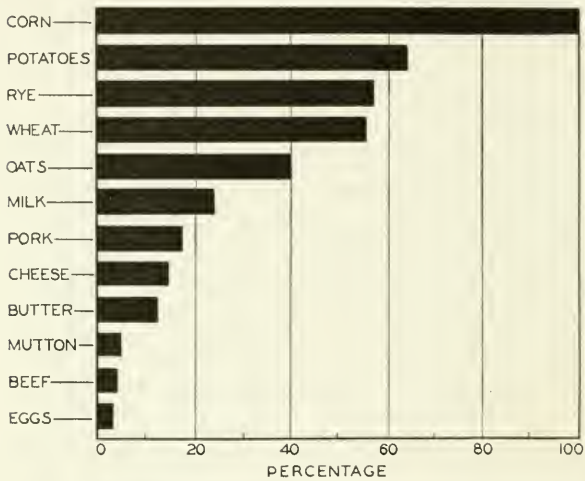

FIG. 30.—Graphs showing relative food values, in calories per acre, of twelve farm products. (Data from U. S. Dept. Agr., Farm. Bul. 877, p. 4, 1917.)

cents per bushel), and $2.50 for winter wheat (valued at $1.24 per bushel); and the net loss per acre was $4.18 for oats (valued at 37 cents), and $3.10 for soybeans (valued at $1.34).[16]

Evidence of the large-scale type of grain production in the prairie province is found, not only in the number of tractors per square mile (page 72) and in the value of farm machinery and implements used, but also in the average size of the farms. In 1925 the average size of farms

[15]Ill. Agr. Exp. Sta., *Graphical Summary of Illinois Agriculture*, Field Crop Section, 1928-1929.

[16]Case, H. C. M., *et al.*, *op. cit.*, p. 265.

in Illinois was 136.2 acres, while in the prairie province it was as high as 162.4 acres. In 1920 the average in the Ohio and Indiana section of the Corn Belt was about 100 acres.[17] The trend through the Corn Belt is toward larger farms. In 1900 the average for the Corn Belt was 143 acres; in 1910 it was 149 acres; in 1920 the figure had increased to 153 acres; and it is still larger today.[18] This increase has been made possible by more efficient machinery, and the use of more power, together with greater efficiency in management.

In all except the Ohio section of the Corn Belt, husking from the standing corn is the usual method of harvesting. It is much cheaper, as it requires less labor, than cutting and shocking; hence it is the method generally used in the central and western Corn Belt. The man labor required per acre of corn varies in different areas. In Indiana the average is 25½ hours; in western Illinois it is 19½, which is 3 hours more than that required in the prairie province.[19] (See Fig. 29.) The influence of the topography as seen in the use of large machinery in these areas accounts to some extent for this difference.

TABLE 9.—PERCENTAGE OF LOSSES FOR EIGHT CROPS IN THE UNITED STATES, AVERAGE 1909-21 (EXCEPT COTTON, 1909-20, INCLUSIVE)

Totals may exceed sum of separate items as they include minor unlisted factors*

	Corn	Wheat	Oats	Cotton	Rice	Hay	Tobacco	Potatoes
Deficient moisture	14.6	12.1	13.1	10.7	5.6	12.4	9.0	13.8
Excessive moisture	4.0	2.4	2.9	5.6	4.0	1.6	4.1	3.2
Floods	0.9	0.3	0.3	1.1	1.3	0.3	0.6	0.3
Frost or freeze	2.3	3.8	0.9	1.3	0.3	1.5	0.9	1.5
Hail	0.4	1.1	0.8	0.4	0.0	0.1	0.8	0.1
Hot winds	1.9	2.2	2.2	1.3	0.4	0.5	0.2	0.8
Storms	0.7	0.3	0.4	0.6	1.6	0.1	0.3	0.0
Total climatic loss	24.9	22.7	21.0	21.5	13.4	17.3	16.2	20.0
Plant diseases	0.3	3.2	2.3	1.6	1.3	0.1	0.9	5.2
Insect pests	2.9	2.5	1.1	11.6	1.0	0.6	2.7	3.4
Animal pests	0.2	0.2	0.1	0.0	0.3	0.1	0.0	0.1
Defective seed	0.6	0.1	0.2	0.2	0.2	0.0	0.1	0.3
Total loss	29.3	30.0	25.4	36.3	18.4	19.1	21.3	30.2

*U. S. Dept. Agr., *Yearbook*, 1921 and 1922.

Table 9, showing the average extent of crop loss due to various factors, indicates the dominant importance of climate. In the United States the loss for the corn crop during the years 1909-21 was approximately 29 per cent of the total, and 24.9 per cent was due to climatic factors. Ideal climatic conditions for corn are more nearly approached in the Corn Belt than elsewhere, and consequently the danger of loss to the crop is smaller here.

[17] Baker, O. E., *op. cit.*, vol. 3, p. 459.
[18] *Ibid.*, p. 460.
[19] *U. S. Dept. Agr. Yearbook*, 1921, p. 191.

There are now many uses for cornstalks and other parts of the corn plant, which until recently were considered largely waste materials. Wall board and good paper have been successfully made from this raw material. Experiments show that cornstalks are one of the two best sources of alpha cellulose (spruce being the other) from which rayon is made. Furfural, a product of the distillation of corn cobs, oat hulls, and similar waste material, is now used in the manufacture of synthetic resins, solvents, and insecticides, and other uses for it are being developed.[26] There seem to be great possibilities for the cornstalk industry as our timber resources become less; but such an industry, by utilizing the stalks, would necessitate a price paid to the farmer to permit extensive purchase of commercial fertilizer to take the place of the plant foods returned to the soil when the stalks are plowed under.

About 8 per cent of the corn crop of the United States is used in the manufacture of corn meal, starch, alcohol, corn sugar, corn oil, gluten, and hominy. As people become more familiar with the qualities of food made from corn, it is probable that a larger percentage of the crop in the prairie province will be used in this way.

Oats and Winter Wheat

Oats and winter wheat are the small grain crops in the prairie province. In both acreage and value, oats rank second only to corn in this region, winter wheat taking third place (Fig. 23). Though the province comprises less than one-fourth the area of the state, 42.6 per cent of the total acreage of oats is in this region. The average yield of oats is 34 bushels per acre in the province, as against 19 in the state as a whole. Similarly, the average yield of wheat is 20 bushels per acre, as against 13 throughout the state; but only 19.8 per cent of the state's acreage of wheat is in this region. The distribution of oats resembles that of corn, with which it is commonly rotated in the province. Although the climate is better for oats farther north, the fact that the labor requirements of this crop fit in so well with those of corn makes it generally advantageous to raise both on the same farm each year.

In general the line separating winter wheat from oats follows that of the 23° F. isotherm in winter. As has been mentioned, this division may be due in part to the fact that in the southern part of the Corn Belt, corn can be harvested in time to seed wheat in the fall, whereas farther north this cannot be done and it is necessary to use a spring-sown crop. The larger acreage of oats is in the northern part of the province, while the winter wheat acreage is highest in the southern part (Figs. 27 and 28).

[26] *U. S. Dept. Agr. Yearbook*, 1927, p. 171.

While oats are the least profitable of the small grains, acre for acre, they occupy a place which is hard to fill with any other small grain. As stated, it is difficult to grow winter wheat after corn in the prairie province, but oats fit in well between corn and wheat, and so provide a workable succession of crops. The labor requirements also fit in well with the demands of corn and wheat. Oats are an especially good nurse crop for the seeding of clover and alfalfa. One reason that oats are less profitable than other crops is that they are usually planted on land which has grown two or more cereal crops since it was in legumes, coming in between corn and wheat; consequently the oats do not have the same opportunity to return a profit.[21] The use of horses for machine farming has provided a domestic market for the oat crop.

Hay and Forage

Of the four chief crops hay ranks third in acreage in the prairie province, but in value it takes fourth place after wheat (Fig. 23). The acreage of hay in the province (Fig. 26) accounts for only 14.4 per cent of the total hay acreage of the state, so that it is of less importance than the grain crops in the prairie province. The principal hay crops here are timothy and clover, grown separately or mixed, and alfalfa.

Trends in Crop Production[22]

There have been important changes in the crops grown and in the acreage in the state during recent years. The wheat acreage in the state and in the prairie province has not changed materially since 1910. There have been some sharp fluctuations due to winter killing and the artificial stimulation of the war period, but for the years 1910, 1924, and 1929 the state acreage was practically the same, approximately 2,400,000 acres. In the prairie province it was about one-fifth of the state total for those periods.

Since 1919 the corn acreage in Illinois has never reached the pre-war average. The drop in that year was due to increased wheat acreage as the result of the European demand, owing to war conditions. The acreage recently has been about one million acres less in the state than it was in the five pre-war years. There was also a considerable drop in the state in 1927, and especially in the counties of the prairie province, owing to adverse climatic conditions, late frosts, and prolonged rains in the spring. However, the better yields resulting from better seed selection have kept

[21] Case, H. C. M., *et al., op. cit.*, p. 266.

[22] Valuable assistance on this section was received from Mr. C. C. Burns, Champaign County Farm Adviser.

production from falling off at the same rate. Corn acreage may be said to be decreasing in favor of soybeans and hay crops.

The acreage of oats in the state has been fairly well maintained since 1910. There has been a decrease in the prairie province, but in the acreage in the livestock section west of the Illinois River there has been an increase. Oats have suffered from a weak market demand resulting from the replacement of horses and mules by motor power. They are being replaced by soybeans, which, though primarily for dairy feed, are now being used largely for hogs.

Recently there have been notable changes in the crops used for hay. Some years ago there was an effort made to use alfalfa more widely as a hay crop, because it is considered one of the most profitable legumes. The acreage in the prairie province increased between 1924 and 1927, but was decreased greatly by winter-killing in 1928, and in 1930 it was about equal to that of 1924. It is doubtful whether alfalfa will replace other hay crops in the province, to any large extent, as the winters here have proved rather too severe for it. Alfalfa is more subject to winter-killing on soils which are rich in organic matter, and hence more porous, such as those of the prairie province. Killing is caused by the frost "heaving" the seed or crown out of the ground.

All hay in Illinois is increasing in spite of the decreasing number of horses, partly because clover crops are essential to good rotations. Soybeans are also used for hay in the prairie province. In this area it is usual to cut a strip of considerable width around each soybean field for hay, "to open up the crop." In this way the farmer arranges to have a supply of hay for his livestock without interfering with his regular soybean crop.

The area of soybeans grown in Illinois has increased from only a few thousand acres prior to 1916 to about 689,000 acres in 1930. Acreage data for this crop are somewhat confusing, because prior to 1927 soybeans interplanted with corn were counted. The acreage for the past four years in the prairie province and the state is shown below:

	1927	*1928*	*1929*	*1930*
Prairie Province	110,390	110,500	112,600	198,050
State	429,000	463,000	514,000	689,000

This crop has risen to importance chiefly on account of its high protein value as a feed for hogs. There are now large soybean mills in the state, the chief being at Peoria, Bloomington, Decatur, and Taylorville. One part of the bean meal is mixed with two parts of corn meal, and as feed for hogs this is giving excellent results. With the decrease in the number of horses and mules on the farms, there is less need for oats. Soybeans form a good substitute for oats in the rotation and are extremely valuable

for adding nitrogen to the soil. Oil is an important product of the soybean, 7½ pounds of oil and 48 pounds of meal being obtained from a bushel of beans.

Livestock

Crops, having a narrower climatic range than pasture, and also yielding normally a greater gross product per acre, whether measured by quantity or value, have first choice of the land; that is, crops tend to displace pasture on the more productive soils. Some land, however, in most systems of farming is kept in pasture in order to lessen the amount of labor required by livestock during the summer season when crops need attention, and also because pasture promotes the maintenance of soil fertility. As has been shown, the prairie province is primarily a grain-producing region, but hogs and dairy cattle are of increasing importance. The changes in the trend of the livestock industries in this region, to some extent, reflect the changes in the trend of crop production.

As the prairie province is in the center of the Corn Belt, it follows that hogs are raised on many of the farms, though not to the same extent as in the western section of the state. The map of distribution of swine in Illinois (Fig. 25) shows that the hogs thin out in the east-central part of the state. The number of hogs in the prairie province increased from 1,101,000 in 1920 to 1,252,000 in 1928, the proportion of increase corresponding to that in the state as a whole. The value of the hogs in the province in 1925 was $14,000,000. The hog industry is now so well established here that changes in trend are the result of economic conditions in the swine industry of the country as a whole rather than in this small area itself. The increase in the use of soybeans as feed for hogs has improved the quality of the pork. Cooperative concentration points for marketing the hogs have recently been established in Champaign, Danville, Mattoon, Decatur, and Paris, and from these cities shipments of selected hogs are now made to Indiana and Kentucky. In this way the farmers are endeavoring to establish a market for their hogs beyond the borders of the state.

The cattle in the province were valued at $23,000,000 in 1925, when the figure for the state was $103,000,000. The number of cattle (520,000), however, was only about half the number of hogs (1,158,000). Dairy cattle are more important in the northern counties of the province, bordering the Chicago region, while along the western edge of the province beef cattle are more largely reared. Here the beef and pork region of the western half of the Illinois corn section extends east into the grain section of the province in the counties along the Illinois River which have a rougher topography. Dairy cattle have decreased in the province as

they have in the state as a whole. In spite of the marked decline in numbers between 1925 and 1929, there was an increase in the amount of milk produced.[23] In the years 1920-1925 the number of milk cows in Illinois remained stationary, but the milk production increased 17 per cent, while in the province it increased 25 per cent.[24] The increase in milk production in the northern counties of the province may be attributed to the growing demands of the Chicago market, to the increased demands of the cities within the province itself, and to more diversified farming. There has been a notable advance in feeding methods in these counties, and in careful selection of the dairy stock.

[23]Baker, O. E., "Regional Changes of Farm Animal Production in Relation to Land Utilization," Fig. 43, p. 100.

[24]*Ibid*, Figs. 38 and 40; and comparison of U. S. Census data for 1919 and 1925.

CHAPTER VIII

MINERAL INDUSTRIES

Coal and Coal Mining

Of the total value of Illinois mineral products during the five-year period 1922-1927, approximately 63 per cent was from coal, only about 8 per cent of which was mined in the prairie province,—agricultural products being of greater value than either manufactured or mineral products in this region. The most important coal-mining areas are beyond the boundaries of the province (Fig. 31), but operations of considerable importance are carried on in Vermilion County. The total production for the state in 1928 was 55,948,199 tons, and the production in the counties of the province was as follows:[1]

County	*Net Tons*
Bureau	4,784
Edgar, Macon, and Logan	305,199
La Salle	420,279
Livingston	22,473
McLean	312,511
Marshall	12,334
Tazewell	576,872
Vermilion	3,358,082
Total	4,700,061

Coal was first discovered in Illinois in La Salle County by Father Hennepin in 1679. The coal here was the foundation of the industries of the northeastern part of the state until deposits of better quality were discovered in the southern part. The combined output of all the other counties of the province, apart from Vermilion, is only about a million tons. The Tazewell producing area is included in the Fulton-Peoria coal district, only a very small fraction of which extends into the prairie province. In La Salle County coal mining is now of little importance; the output in 1930 was approximately 200,000 tons, of which at least 90 per cent was used locally, two mines being owned by zinc companies in the locality.[2] The Bureau County production is now practically negligible, being barely 3,000 tons in 1929.

The Pennsylvanian rocks of Illinois fill a great spoon-shaped depression, the whole system being plano-convex in shape, with the thickest beds where the basin is deepest. Because of this structure the mines of the

[1] U. S. Bur. Mines, *Mineral Resources of the United States in 1928*, Part II, p. 545.

[2] Personal communication from Dr. G. H. Cady, Illinois State Geological Survey.

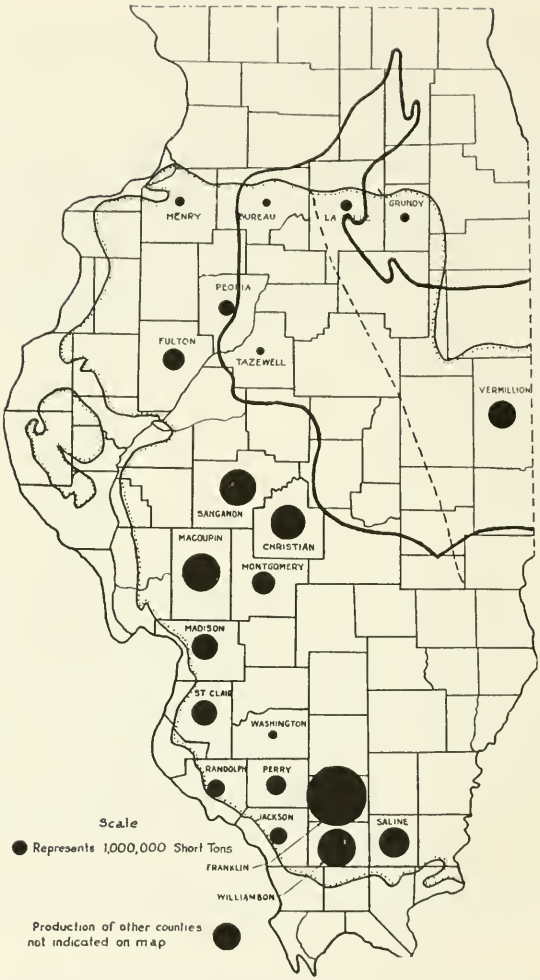

FIG. 31.—Map of Illinois showing coal production by counties in 1926. The broken line represents the La Salle anticline. (Data from Illinois Geological Survey.)

state range from surface drifts to shaft mines 1,000 feet deep. The deepest bituminous coal mine in the United States is at Assumption in Christian County, just beyond the southwest boundary of the prairie province. An important characteristic of the coal mines of the state is the general absence of structural irregularities. Faults and other disturbances are not numerous, and mining operations, in general, avoid the regions where irregularities are found. The most important of these is the La Salle anticline, which begins east of the city of La Salle and extends in a southeasterly direction across the prairie province and into Crawford and Lawrence counties. In Champaign, Douglas, and Coles counties, the Pennslyvanian strata have been entirely removed from the crest of the fold so that the coal-bearing rocks of Vermilion and Edgar counties are isolated from those of similar age in the central part of the Illinois field.[3]

Vermilion, the chief coal-producing county of the prairie province, had a total output in 1928 of more than 3,000,000 tons. There are two main outcrop lines, that of Danville, No. 7, and that of Grape Creek, No. 6, and both of these beds are worked by shafts and side-hill, or slope, mines as well as strip mines, depending upon the relation of the coal beds to the surface of the region. The Vermilion River and its branches have eroded the glacial drift from the surface over considerable areas, and here and there have cut into the coal itself, so that conditions are favorable in a number of places for the development of small slope, or drift, mines and strip mines. The beds lie at varying depths, the deepest shaft in the district being Peabody No. 24, which is 214 feet deep. Where the overburden is too thick to strip the coal profitably, shafts are sunk or openings made from the sloping sides of the valley. In 1928 the county output by the stripping method was almost 600,000 tons, an increase of 100,000 tons over the output for 1926. Many improvements have been worked out here, both in equipment and mining methods, which have made it possible to strip coal today which formerly was considered too deeply buried. One company is now using a 15-yard dipper-shovel where the coal to be removed has a thick limestone cap rock. Coal is commonly considered strippable if its cover does not exceed ten times the thickness of the coal itself. The No. 7 bed of Danville coal varies in thickness from 3 to 5 feet in the stripping area. The No. 6 bed of Grape Creek coal is generally more than 6 feet and is freer from impurities than the No. 7 bed. When the coal is removed by stripping, the land is of no further value for a considerable period of time. The damage may be of little consequence in locations where the surface has no agricultural value. In other localities, however, where the land is valuable for crops, stripping may not be advisable, if one considers the returns over a long period.

[3]Bement, A., "Illinois Coal," pp. 33 and 34.

TABLE 10. COAL OBTAINED BY STRIPPING OPERATIONS IN ILLINOIS IN 1928*

Counties	Number of Strip Pits	Number of Shovels	Coal Produced by Stripping (net tons)	Men Employed	Average Days Worked	Average Tons per Man per Day
Edgar, Fulton, Jackson, La Salle, Peoria, St. Clair, Saline, and Will	9	35	2,342,183	617	243	15.63
Livingston	3	1	7,266	18	124	3.25
Perry	3	12	1,035,843	261	224	17.72
Vermilion	6	10	591,314	242	225	10.87
Williamson	9	9	362,836	199	107	17.09
State Total	30	67	4,339,442	1,337	214	15.16

*U. S. Bur. Mines, *op. cit.*, p. 495.

Reference to Illinois coal beds is commonly made by seam number, but as the accuracy of widespread correlation of the coals has not yet been demonstrated, it is customary for the State Geological Survey to refer to the coals by local geographic name as well as by number. Thus the more important seams are designated as follows:

Seam No. 1: Rock Island (No. 1), Seville (No. 1), Assumption (No. 1).
Seam No. 2: La Salle (No. 2), Colchester (No. 2), Murphysboro (No. 2).
Seam No. 5: Springfield (No. 5), Rushville (No. 5), Harrisburg (No. 5), Blair (No. 5).
Seam No. 6: Belleville (No. 6), Herrin (No. 6), Grape Creek (No. 6).
Seam No. 7: Streator (No. 7), Danville (No. 7).

Eleven other numbers also have been used, as sixteen seams have been identified. The thickness, quality, and mining conditions of a given coal bed may differ in different parts of the state. It has been found that these numbers cannot be applied widely except with respect to the five thick seams, and it seems possible that even here the application has been too extended.[4]

Illinois coal has a relatively high content of moisture and volatile matter, and it is classed as a low-grade bituminous coal. During recent years, with the increased use of machinery, especially in strip mines, cleaning devices have been installed at the tipples, where the impurities are removed, and the coal is graded according to size on shaker screens. This careful preparation and sizing before it leaves the mines counteracts to some extent the effect of the sub-bituminous character when it is put on the market.[5]

The bulk of the Vermilion County coal is marketed in the Chicago district and in the iron and steel district of northwestern Indiana. Small shipments go eastward, some as far as Indianapolis. A considerable

[4]Bement, A., *op. cit.*, p. 32.
[5]*Ibid.*, pp. 77-81.

quantity is purchased by the railroads at the mines, the Illinois Traction Company being one of the chief consumers. A small and annually decreasing amount goes to Wisconsin.[6]

The presence of coal in the Danville area has fostered the development of the clay products industry there, and it was also one of the chief reasons for the establishment of a zinc-smelting plant near the city. The fact that the plant still persists and prospers although most of the zinc ore now comes from Joplin, Missouri, is evidence of the importance of cheap and accessible fuel.

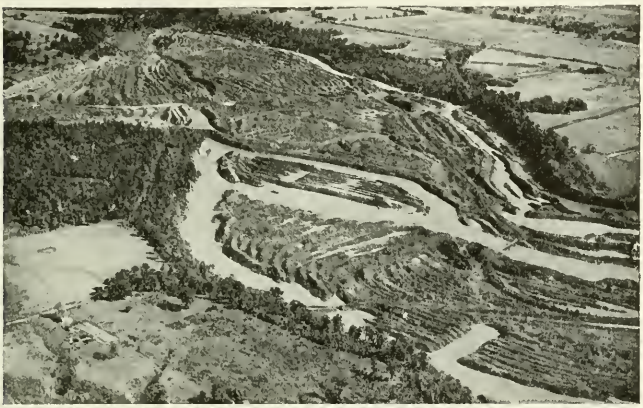

FIG. 32.—Airplane view of strip-mine operations near Danville, Illinois. (Courtesy of United Electric Coal Company.)

At Bloomington in McLean County there is a shaft sunk into the No. 2 coal. This is the largest mine in the state producing coal for local consumption. None of the coal is shipped, and practically all of it is marketed in the city. At Decatur in Macon County there are two important shaft mines in the No. 5 coal that supply a portion of the local demand.[7]

CLAY AND CLAY PRODUCTS

Among the mineral industries of the state, that of clay and clay products takes second place on the basis of value of output. Apart from the works located in the Illinois valley, which is outside this discussion,

[6] Personal communication from Dr. Cady.
[7] Bement, A., *op. cit.*, pp. 61-62.

Vermilion County only is important in the prairie province, for this industry (Fig. 34). Extensive deposits of shale of excellent quality and unusual thickness lie just above the No. 7 coal in this county. The ease with which clay and coal can be obtained here has made the Danville district a leading one in the manufacture of clay products.

Of the five plants in the Danville area engaged in this industry, the largest are those of the Danville Brick Company and the Western Brick Company. At the former, a stratum of shale 100 feet thick, which is overlain by Nos. 6 and 7 coal, is used for the manufacture of face brick

FIG. 33.—View of steam shovels loading coal near Danville. The overburden on the left is approximately 50 feet thick; it includes about 35 feet of shale immediately above the coal, the remainder being red sandy clay. (Courtesy of United Electric Coal Company.)

and drain tile. The Western Brick Company, about 3 miles west of Danville, is one of the largest face brick plants in the world. Here face brick of every description is made, the shale and No. 7 coal being mined close together on the company's property. This establishment is one of the eight plants[8] in the United States which manufacture haydite, a lightweight burned-shale aggregate patented by Stephen J. Hayde in 1918. Haydite is a vesicular, clinker-like aggregate, which, because of its semivitrified nature, has exceptional strength, considering its light weight

[8]Eight plants with a total of 14 kilns were manufacturing haydite in the United States and Canada during 1930, as contrasted with one kiln in 1918. The plants in the United States are at Kansas City, East St. Louis, Danville, Cleveland, Pittsburgh, and Buffalo.

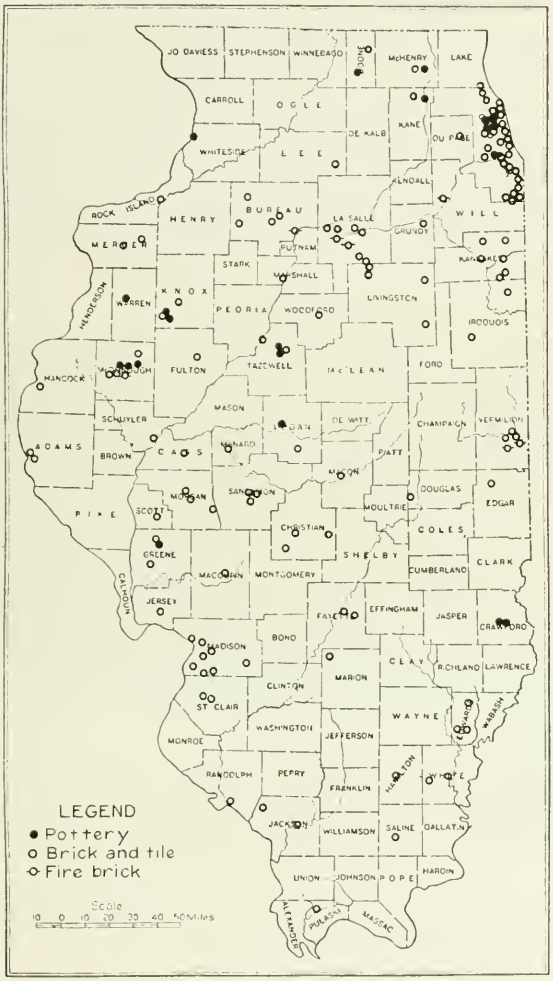

FIG. 34.—Distribution of clay products plants in Illinois in 1927. Brick and tile and fire brick are the chief clay products of the prairie province. (From Leighton, 1930.) (Courtesy of Illinois Chamber of Commerce.)

(only 100 pounds per cubic foot). This product is less dependent upon raw materials than other aggregates of the light-weight group. Practically any shale or clay is satisfactory, although material containing some carbonaceous matter, like that found in this locality, gives the best results.

There is a large demand for bricks of all kinds in Illinois, owing to the shortage of other building materials. Although the clay and clay products industry reaches larger proportions in the Chicago region than elsewhere in the state, that region is the chief market for brick and haydite from the Danville area. St. Louis, Milwaukee, and Detroit also take large consignments. Drain tile is marketed locally, within a radius of one hundred miles, to the farmers of the black silt loam in this region.[9]

Limestone

The only other mineral product obtained in the prairie province that deserves mention is limestone. The rocks exposed at the surface in Vermilion County are of Pennsylvanian age and consist of shales and sandstone with thin beds of limestone. In only one place is the limestone sufficiently thick to warrant quarrying, namely, at Fairmount. Here for years the United States Steel Company operated the Caparis quarry and took the entire output for use in its steel mills at Chicago.[10]

The large and increasing demand for agricultural limestone in Illinois has led to a consideration of the crushing of limestone occurring over coal in some of the strip pits. In most instances the limestone is entirely suitable for agricultural purposes, and since it must be handled anyway, the operators would do well to consider the utilization of this by-product of coal stripping. At least one pit has arranged to market the stone thus obtained. The bulk of the crushed limestone used in the prairie province as a fertilizer is obtained from quarries near Chicago, although there is no reason why this local material should not be used if the coal companies will crush it.

[9] Information supplied by the Western Brick Company and the Danville Brick Company.

[10] This quarry has recently been closed, but the Illinois Steel Company works an adjoining section.

CHAPTER IX

SETTLEMENT AND DEVELOPMENT

Before railroads were built in Illinois, waterways were the all-important factor in the distribution of the population. The rivers in the south and the Great Lakes in the north were the highways of exploration, immigration, and trade; consequently, the state drew its settlers from widely separated areas. Northern Illinois was settled by emigrants from New England and the Middle Atlantic States, coming by way of the Great Lakes. Settlement began earlier in the south than in the north largely because of the excellence of the Ohio River as a route to the interior. From this river the pioneers pushed northward along the Wabash, Kaskaskia, Illinois, and Mississippi, and their tributaries. The prairies were settled last, partly because they were on the divides, away from the water courses.

By 1820 Illinois had a population of 55,200—practically all within the forested areas where running water, fuel, and shelter were available. The prairies, lacking these necessities, were looked upon as unfit for settlement, and it was a common belief among the pioneers that grassland was inferior to soil which supported trees. After a visit to this part of the state, Monroe wrote to Jefferson: "A great part of the territory is miserably poor, especially that near Lake Michigan . . . . and that upon the Illinois consists of plains which have not had, from appearances, and will not have, a single bush on them for ages. The districts, therefore, within which these fall, will never contain a sufficient number of inhabitants to entitle them to membership in the confederacy."[1]

About 1830 the current of migration began to set in from the northeastern states to Illinois. The opening of the Erie Canal gave impetus to this movement. Although the Illinois-Michigan Canal was not opened until 1848, its influence was felt much earlier, as towns were laid out along its course during the construction from 1836 to 1848, and the population map for 1840 (Fig. 35) shows that while the Grand Prairie still had a population averaging less than 6 to the square mile, it was encircled by a region of denser population which followed the water courses.

The discovery that the prairie was good crop land, about 1830, initiated a flood of immigration, and by 1840 less than 4 per cent of the province remained unsettled, the finest black-soil belt of Champaign and Ford counties being the last to be opened up. During the decade 1830 to 1840 over 300,000 people settled on the prairies. The beginning of work

[1]Boggess, A. C., *The Settlement of Illinois*, p. 97.

on the National Road through Cumberland County in 1832 was an impetus to immigration and attracted settlers to that vicinity from Ohio. There was also a movement farther north from Ohio and Indiana directly into the prairie of east-central Illinois stimulated by the economic conditions resulting from the panic of 1837.[2]

Railroads did not exist, and overland wagon-haul for lumber was out of the question; hence local supplies of timber were controlling forces in the settlement of these grasslands, which could not be sold unless several acres of forest land were included. The relative value of prairie and forest per acre was about 1 to 7, the former commonly selling for $5 and the latter for $35 per acre.[3]

The character of the population in the prairie province differed from that in the north or south of the state, in that a considerable number of the settlers came from Ohio and Indiana. There were no trunk lines of transportation leading into the province, and since many of the pioneers came from the neighboring states, it seems reasonable to believe that settlement here was the result of a gradual movement of the agricultural classes, due to the belief that opportunities were better "farther west."[4]

At a comparatively early date, lines of communication were established from Chicago to various points in eastern and central Illinois. The chief road to the settlements along the Vermilion and Wabash rivers was the "Hubbard Trace," or "State Road," leading from Chicago to Danville. In 1836 a line of wagons operating between Chicago and the Kankakee River was established.[5] Where well-travelled roads such as these crossed the prairie, a string of settlers' cabins would be found. Thus the filling up process between the timber settlements began, but it was carried on slowly because of the scarcity of routes. In the northeastern part of the province, swamp lands practically prohibited settlement, and it was not until these were drained that Kankakee and Iroquois counties were settled to any considerable degree.

Danville, situated on the Vermilion River, which was navigable for steam boats for the greater part of the year, was the chief settlement in this part of the state, with a population of nearly 500 in 1835.[6] Coal mining, which later was to become the most important industry in this district, had begun, but the settlers did not realize the value of the coal and were content to dig only enough for their immediate use.[7]

[2] Pooley, W. V., *The Settlement of Illinois from 1830 to 1850*, pp. 347 and 448.
[3] Telford, C. J., "Third Report on a Forest Survey of Illinois," p. 6.
[4] Pooley, W. V., *op. cit.*, pp. 440-460.
[5] *Ibid.*, p. 359.
[6] Coffeen, H. A., *Vermilion County*, p. 61.
[7] Beckwith, D., *History of Vermilion County*, p. 847.

In the prairie section the population in 1850 was dominantly rural. There were but four settlements with more than 1,000 inhabitants, and only nine others with 750. Agriculture was the chief occupation, and the products were stock and grain. The great requirement was a market, and inland towns such as Bloomington could not furnish it, because there were no lines of transportation whereby the accumulated produce could be transferred to larger markets. As soon as the railroads from Chicago tapped this region, and not until then, was its future assured.

In 1849 attention was drawn to the prairie land west of Vermilion and Edgar counties, and there was a rush of population away from the Wabash River settlements towards the central part of the state, which was to be traversed by the first line of the Illinois Central Railroad. McLean County, having an abundance of undulating timber land and being nearer to the older settlements of the Illinois valley, was now rapidly settled. The names of some of the early villages, Dry Grove, Blooming Grove (later Bloomington), and Funk's Grove, are significant; for few settlers ventured away from the timber before 1850.[8]

Champaign County, lying in the heart of the prairie, and consequently lacking timber, did not fill up so rapidly. Urbana, Mahomet, St. Joseph, and Sidney all had settlers by 1840, but there was no city of Champaign on the map,—that being entirely a product of the railroad which crossed the county in the next decade. De Witt and Piatt counties were settled slowly. Farmer City in the former, on Salt Creek, and Monticello in the latter, on the Upper Sangamon, were settlements in 1840, both having the advantage of timber and water supplies. Macon County was settled early along the Sangamon River. Decatur, a mere hamlet in 1836, began to grow rapidly in the next decade (1840-1850), partly because of the belief that a railroad was soon to be built through the town.

In general, it appears that previous to 1850 only beginnings of settlement were made in the prairie province. For several reasons this region was unattractive. First, there was the lack of timber; secondly, much of the land was swampy and required draining, so that fever and ague attacked the pioneers and proved a drawback to settlement; thirdly, although there were no trees to clear, there was a sod to break which was extremely tough and which yielded but slowly to the plough. Generally two or three seasons were necessary to decompose the sod thoroughly and render the soil light and loose enough to be cultivated. The greatest drawback, however, to the settlement and development of the prairie province prior to 1850 was the inaccessibility of the country, owing to absence of navigable rivers and roads, and consequent lack of markets.

[8] *History of McLean County*, p. 501.

The Period of the Railroads and the Civil War (1850-1870)

In 1850 Congress granted to the State of Illinois more than 2,500,000 acres of land, the proceeds to be used in the construction of a north and south line of transportation across the state.[9] The Chicago branch of this railroad gave direct connection between Chicago and the mouth of the Ohio River, and crossed the central part of the prairies on the divide between the Wabash and the Illinois. The main line of the road traversed the western part of the same prairie belt. Thus the Illinois Central completed in 1856 two lines of communication across this section of the state (Fig. 40). The Chicago and Alton, the Wabash, the St. Louis and Pacific, and the Rock Island lines were also built at this time. Besides these railroads, the Illinois-Michigan Canal, constructed in 1848, provided another transportation route and greatly increased the value of the land which it traversed. A transportation system with a primary commercial center at Chicago was in this way established.

The survey of the Illinois Central route stimulated settlement, and when the road was completed the tributary country was dotted with towns and new farm houses. Ackerman, writing of the conditions along the Chicago branch before its completion in 1856, said: "In 1853 we rode for 20 miles on this division without seeing a tree, house, or any living thing save an occasional prairie dog."[10] By 1856 "these immense uncultivated tracts" had been transformed into cultivated lands contributing many million bushels of excellent grain to the general produce of the state.[11]

Comparison of the Census reports of 1850 and 1860 with maps showing population density (Fig. 35) reveals the extent of the development which the counties of the prairie province underwent in this decade. All of the twenty counties show an increase of over 40 per cent, and most of them much more. In Champaign County the increase was seven times that of the 1850 population, and in Piatt County five times.[12]

The Illinois Central did everything in its power to encourage immigration and the purchase of land. In 1855 the prices ranged from $5 to

[9]The Illinois Central Railroad Company received a federal grant of 2,505,000 acres of public land, consisting of alternate sections on either side of the proposed route. The proceeds from the sale of the lands were to help defray the cost of construction. The grant, however, was not a gift, as many persons have believed. There were strings tied to it. One was that the railroad should transport forever all troops and government supplies at one-half the standard rates; another was that United States mail should be transported at 80 per cent of the standard rates. Still another was that the Illinois Central should forever pay to the state treasury, in lieu of other taxes, 7 cents out of every dollar received for the transportation of passengers, freight, express, and mail over the 705½ miles of the chartered line. *Illinois Central Magazine*, vol. XVIII, no. 7, p. 10, Jan., 1930.

[10]Ackerman, W. K., *Early Illinois Railroads*, p. 42.

[11]Gerhard, F., *Illinois as It Is*, p. 404.

[12]*Illinois Blue Book*, 1900, p. 287.

$25 an acre, "according to the location, quality, and distance from the station." This was land which the United States Government had offered for years without purchasers at from $.62½ to $1.25 per acre. Although of great fertility, it had been practically valueless because of the lack of transportation facilities.[13] It is interesting to note that likely purchasers were informed that "wood is delivered to the stations along the line of the road at $3 to $4 per cord." They were also told where coal could be obtained. In a pamphlet published by the company in 1859, a detailed description of the chemical composition of the prairie soil is given, showing how favorably it compared with some of the richest farm lands of Britain.[14] However, sales to settlers were slow, for even as early as 1852 speculators had bought almost all the land and had placed high values upon it. The panic of 1857, following closely upon the sales that were made, compelled the surrender of much land which had been purchased for cultivation.

The owners of this fertile land found it very difficult to cultivate with the old iron plow then in use. The stiff prairie soil stuck to the share, which had to be cleaned continually with a wooden paddle. In 1833 John Lane, Sr., conceived the idea of making plows of steel, using old mill saws which would keep bright and need no cleaning. His plows were soon in such demand that all the old saws and quantities of new ones were used in plow manufacture. Later John Deere improved on this implement and used steel, rolled especially for plows. In 1868, however, the manufacture of steel plows was completely revolutionized by John Lane, Jr., of Homer, in Cook County, Illinois, who invented the three-layer-metal for mold boards and plow shares. This metal was composed of two layers of steel with a middle layer of soft iron. The weld was rolled down into plates and could then be hardened without warping, and was strong yet not brittle, by virtue of its soft center. This invention was of great importance in the development of the prairie section of the state.[15]

By 1860 Illinois had become the center of the agricultural life of the nation. During the Civil War the demand for foodstuffs to feed the Union armies, together with the poor European harvests in that period, served to stimulate prices. In the early years of the war there was a withdrawal of a quarter of a million workers, mainly from the farms of the state, to join the Union forces. As a result wages increased, negro "contrabands" and women and children worked in the fields as farm

[13] *Illinois Central Magazine*, vol. 18, no. 7, p. 9, Jan., 1930.
[14] *Illinois Central Railroad Company Offers for Sale Prairie, Farm, and Woodlands*, Chicago, 1856, p. 7.
[15] Information supplied by R. I. Shawl, College of Agriculture, University of Illinois.

laborers, white men being a rare sight.[16] Oxen had been largely used as draft animals but now were replaced by horses. The use of farm machinery increased considerably. In 1861, Illinoians took out 80 patents, or over one-seventh of all patents granted for such machines, 17 for cultivators, 15 for harvester machines, 11 for plows, and 10 for corn planters. Because of the level topography, the prairie counties especially came to be exploited by farm machinery. In Champaign County, for instance,

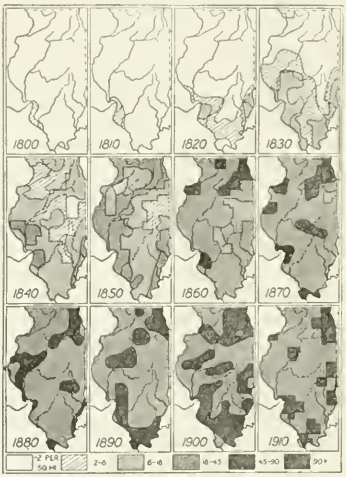

FIG. 35.—Population density, at intervals of one decade, from 1800 to 1910, in Illinois. (After Ridgely.)

the value of farm machinery increased from $25,000 in 1850 to over $600,000 in 1870.[17] With the aid of farm machinery the Illinois farmers, in spite of the large enlistments during the Civil War, increased their production of food sufficiently to meet the enormous demands of the eastern states from 1860 to 1870.

During the period of 1850-1870 the value of land in the counties of the prairie province advanced considerably. The Illinois Central advertised well-drained, rolling land in Champaign and Piatt counties, at from $13 to $16 near the railroad, and from $10 to $13 at a distance. These lands are described as being essentially prairie, watered by considerable

[16] *Carthage Republican*, June 9, 1864.
[17] Cole, A. C., *The Era of the Civil War*, p. 372.

streams along which there was "quite an amount of timber."[18] The twenty typical agricultural counties of the east-central part of the state had more than seven times as many acres under cultivation in 1870 as in 1850; thus in Champaign County the increase was from 22,000 acres to 419,000 acres, in Livingston County from 13,000 to 317,000 acres, and in Iroquois County from 20,000 to 322,000 acres.[19] This period was remarkable for the advance made in settlement and agricultural development in the prairie section of the state. Between 1850 and 1860, railroads were built across this region, and as a result the entire prairie, for the most part sparsely settled in 1850, became within a decade a thoroughly cultivated and highly productive part of the state. These years were the beginning of the railroad era, a period of economic revolution. The year 1855 may be said to mark the close of steamboat supremacy in the trade of the Illinois valley. The early settler faced the river; from now on he turned and faced the railroad. With his back to the river, whose banks were no longer the most desirable locations for home-building, the pioneer from this time centered his interests on the prairie. Timberland became relatively less important, while the open prairie came to be appreciated at its real value, and almost every acre of what had been considered a useless section of the state was now utilized.

The Transitional Period (1870-1893)

During the following two decades the population continued to increase, but at a slower rate. From 1850 to 1860 the increase had been 101.1 per cent, and from 1860 to 1870 it was 48.4 per cent, and from 1870 to 1890 it was only 22.7 per cent.[20] By 1870 the prairie province everywhere had a population density of over 18 per square mile, except in the undrained marshland of the northeast, and a density of over 45 to the square mile in the southwestern counties, where the east-west extensions of the railroads followed the Sangamon River.

By 1860 the transition in this section from the "self-sufficing" stage, where the farmer produces practically everything he needs, to commercial agriculture, where he specializes on a money crop and buys most of his supplies with the proceeds, had been practically accomplished. The new transportation facilities, the widening areas of consumption, and the improved methods of marketing led the way for specialization and territorial division of agriculture.[21]

Until 1870 Illinois was primarily an agricultural state. The major part of the population was engaged in agriculture; other pursuits, such as

[18]Illinois Central Directory, 1869, p. 82.
[19]Brownson, H. G., *History of the Illinois Central Railroad to 1870*, p. 93.
[20]Bogart and Thompson, *The Industrial State*, pp. 2 and 3.
[21]Bogart, E. L., *Economic History of the American People*, p. 317.

trade and manufactures, were so dependent on this fundamental one, that their growth only served to accentuate the importance of farming. During this period Illinois began to develop along the lines of manufactures and mining, in addition to agriculture, and rose to a high place in each field of productivity. The relative importance of agriculture cannot be gauged by the number of persons engaged in it, as these figures would lead to the conclusion that it was a declining rather than an expanding

TABLE 11.—PERSONS ENGAGED IN AGRICULTURE IN ILLINOIS, 1870-1890*

Year	Total Population	Persons in All Occupations		Persons in Agriculture	
		Number	Percentage	Number	Percentage of Employed Persons
1870	2,539,891	742,015	29.2	376,325	50.7
1880	3,077,871	999,780	32.5	436,322	43.6
1890	3,826,352	1,353,559	35.4	430,134	31.8

*From Bogart and Thompson, *The Industrial State*, 1920.

industry. From Table 11 it is evident that there were fewer people engaged in farming in 1890 than there were ten years before. By 1890 there were three persons in other industries to every one in farming, while in 1870 one out of every two persons gainfully occupied was in agriculture. The explanation lies in the steady transfer of labor from the household to the factory. Whereas domestic industries, such as the making of clothes, butter, cheese, and sugar, butchering and canning, had been carried on in the farm home, they were now becoming centralized in large establishments, though perhaps the work was still done by the same people.

The marked decline in the number of those engaged in agriculture between 1880 and 1890 was partly due to the increased efficiency of the agricultural population. Whereas the number of agricultural workers was only four times as great in 1890 as in 1840 the production of cereals was fifteen times as great. The following tabulation shows the percentage increase by decades, with 1840 as the base year:

Year	*Population Engaged in Agriculture*	*Cereal Production*
1840	100	100
1850	134	249
1860	207	502
1870	357	877
1880	414	1,426
1890	408	1,503

The increase in the productivity of the average farm worker can be largely explained by the introduction of agricultural machinery; and the most marked effects of its extended use were observable between 1870

and 1890.[22] The amount of time so saved may be realized by noting that about 1850, by the old methods, it took 3 hours of man-labor to produce a bushel of wheat, though it now takes only 10 minutes; corn required 1 hour per bushel, as against 24 minutes now.[23]

As the rich land of the prairie province came under cultivation, much of it was found to be wet and swampy and to require draining before it could be cultivated. This was especially the case in the central counties of this section, where the land is level and lies on the drainage divide, for example, in Champaign, Ford, and Piatt counties. In the late seventies an important movement was started for tile drainage. Since that time there has been a steady increase in the acreage of artificially drained land in Illinois, and the increase was especially marked in the last decade. The combined length of open ditch and tile drains in 1919 was 3,012 miles;[24] in 1929 the figure was 10,317 miles.[25]

One of the most important agricultural changes in this period is to be found in the westward migration of the Wheat Belt. Many influences tended to accelerate this movement, such as the extension of the railroads, which opened up new areas to the west and also made it easier to market wheat in the eastern states and ship it to Europe. Owing to the new milling inventions, there was an increased demand for the hard spring wheat of the northwest, as it made better "patent" flour than the soft winter wheat of Illinois and Iowa, which was too sticky for the milling processes of fifty years ago. The rising prices of land in Illinois and the increasing labor supply also tended to encourage wheat production in the new lands of the west.[26]

The chief cereal crops in 1875 were corn, wheat, oats, barley, and rye, in the order given. In 1890, oats were ahead of wheat. The wheat crop showed the greatest loss in acreage and was largely replaced by corn and oats, both of which were utilized on the spot in the feeding of horses, cattle, and swine, or in the production of prepared foods. The central section of the state contributed the bulk of the supply except during the two short periods of 1880-1884 and 1890-1893. In 1869 the center of the Corn Belt was Sangamon County, by 1879 it had shifted to McLean County, and by 1894 Champaign County was the leading corn-growing county, and the tendency to concentrate upon corn production in this section of the state was very evident.[27]

[22] Bogart and Thompson, *op. cit.*, p. 218.
[23] Sanford, A. H., *Story of Agriculture in the United States*, p. 263.
[24] *14th Census of U. S.*, vol. 7, p. 451.
[25] *U. S. Census of Drainage, 1930, Preliminary Announcement.*
[26] Sanford, A. H., *op. cit.*, pp. 209 and 214.
[27] *Ill Dept. Agr. Trans.*, 1874-1894, sections on corn production.

The early failure to utilize the mineral resources of Illinois was due to the concealed geologic structure and to the lack of transportation. In the central portion of the state, as has been shown, the coal measures lie in a shallow syncline, thickly covered with drift. It is only in the counties lying near the boundaries of the state that the spoonlike structure of the rocks brings the coal and clay beds of the Pennsylvanian period to the surface. Hence it seems that even if forests and adequate transportation had attracted settlers earlier to the heart of the prairies, mineral development would have progressed inward but slowly from the state borders, just as it did.

The transportation question has been closely related to the history of the coal industry, the whole face of the situation having changed with the development of the railroads. Transportation of a bulky commodity like coal, over any great distance, was well nigh impossible, except by water, until the railroads came to solve the problem, and shipping mines and their markets were confined to the vicinity of streams during the pre-railroad period.[28] In the prairie province coal was first mined on a commercial scale in Vermilion County in 1866. In the decade 1860-1870 the greatest growth among the twelve chief cities of Illinois was Danville, 191.1 per cent, which illustrates the importance of this development.[29] Vermilion was among the five leading counties for coal production in 1880, and has appeared among the first ten ever since.[30] This county, however, is the only one in the prairie province in which mining is a major industry.

The changes during this period, though perhaps not as spectacular as those of the previous one, were none the less lasting in their influence. There was increased agricultural efficiency, in spite of the decrease in farm population. The regional changes in crop production and the beginnings of the manufacture of agricultural products are outstanding. These together with the rise of mining centers make it apparent that this was a transitional period during which adjustments were being made preparatory to the great advance of industrialism in the state, and changes which materially affected the population trends in the prairie province.

Recent Changes and Trends (1893-1930)

The most striking change in the distribution of population during the last forty years has been the growth of the urban centers, which have absorbed the greater portion of the new comers and even caused a decrease in the rural population in some counties (Fig. 36). During the

[28] Andros, S. O., "Coal Mining in Illinois," pp. 26-30
[29] *Eighth and Ninth Census of the United States.*
[30] Andros, S. O., *op. cit.*, pp. 40 and 41.

earlier decades, 1890-1910, the apparent urbanization of the population proceeded rather from the extraordinary growth of Chicago than from a movement from the farms to the cities in the state as a whole. The population of Chicago increased very rapidly (from 1,099,850 in 1890 to 2,185,283 in 1910) while the increase in the smaller cities was consider-

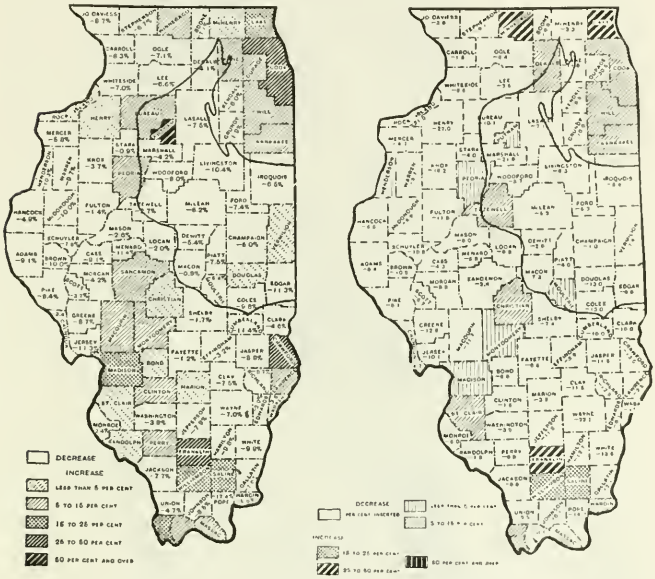

FIG. 36.—Decrease in rural population in Illinois from 1900 to 1920. (From U. S. Census.)

ably less.[31] It is therefore natural to conclude that the growth of Chicago was coincident with the depopulation of the rural districts, and to some extent the cause of it.

This has not been the case in the later decades of this period, as the 1930 statistics show a marked increase in most of the urban centers. In the state as a whole, there has been an increase in the average density per square mile, from 116.7 in 1920 to 135.2 in 1930 (Fig. 37). The increase in the prairie province during the same decade has been much

[31] *Thirteenth Census of the United States.*

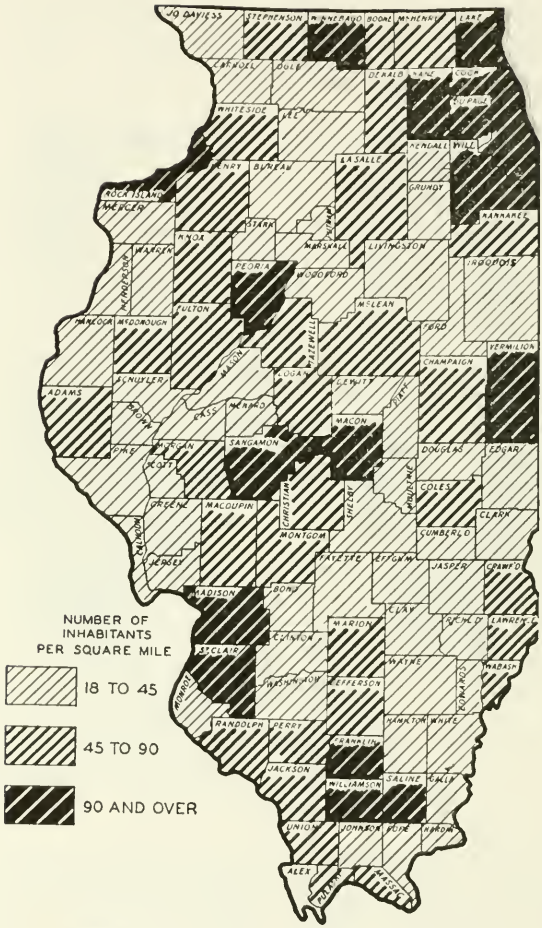

FIG. 37.—Density of population in Illinois in 1930. (Data from U. S. Census.)

smaller, from 52.8 to 54. Even this is misleading, as the only counties that show an increase in this section contain one or more cities—another instance of the fact that the urban centers have recently been drawing the population.[32]

The map of the 1930 distribution of population in the prairie province (Fig. 38) shows the rural type of settlement in this area. Apart from the towns of the Illinois valley, which do not belong strictly to the prairie province, and which have been treated elsewhere,[33] there are only six urban centers with a population of over 10,000. Of these, Decatur and Bloomington were on the original main line of the Illinois Central and later became important as railroad centers. Streator and Mattoon developed as junctions on the east-west lines. (Glass making at Streator is of comparatively recent importance; it is an extension up the Illinois-Vermilion valley, of the Ottawa industry, which is based upon the presence of St. Peter sandstone.) Danville's growth results largely from the coal and clay deposits. The importance of Champaign and Urbana today is largely due to the location of the University of Illinois, the site having been donated by Act of Congress in 1865. In 1854 West Urbana (later Champaign) was merely a depot on the Illinois Central with less than 100 dwellings.[34] Later the east-west line from Bloomington to Danville passed through Champaign and Urbana, and their future was assured. From the two railway maps (Figs. 40 and 41) it will be seen that, apart from Danville, the early development of these towns was due to their nodality.

By 1900 Illinois farmers had launched upon an era of prosperity following the depression which began with the crisis of 1893. Population had again caught up with crop production by 1900 and prices of corn, wheat, and oats began to rise. Land values advanced, particularly in the prairie province. In 1900 the value of land in the state averaged $46 per acre, while that of the prairie province was $61. By 1920 the values had more than quadrupled; for the state the figure was $164 and for the province $268 per acre. By 1930, however, land values in the country as a whole showed a marked decline, and this was reflected in the value per acre in the prairie province, where the average was down to $118 (less than half of the 1920 figure), and the state average was only $83.[35] The enhanced value of the land in 1920 marked a change in agricultural practice, in that the operators, especially if recent purchasers or tenants, were forced to utilize the soil more intensively. A result of this necessity for greater production has been the development of more careful and scien-

[32] *Fourteenth and Fifteenth Census of the United States.*
[33] Sauer, C. O., "Geography of the Upper Illinois Valley."
[34] Cole, A. C., *The Era of the Civil War*, p. 50.
[35] Personal communication from Dr. C. L. Stewart, College of Agriculture, University of Illinois.

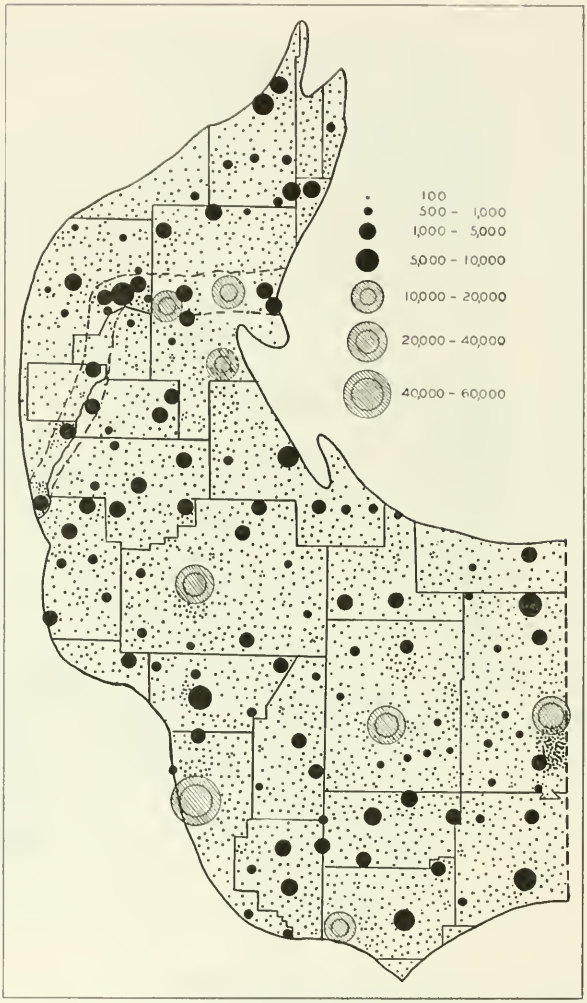

FIG. 38.—Distribution of population in the prairie province in 1930. (Data from U. S. Census.)

tific methods of cultivation, and this is seen in the increased use of fertilizers, crop rotation, and seed selection,—a movement in which the Illinois Agricultural Experiment Station has been a powerful factor.

On an average about 40 per cent of the farms of the Corn Belt are operated by tenants. These are relatively most numerous on the richest land in central Illinois, notably in the prairie province, where the area

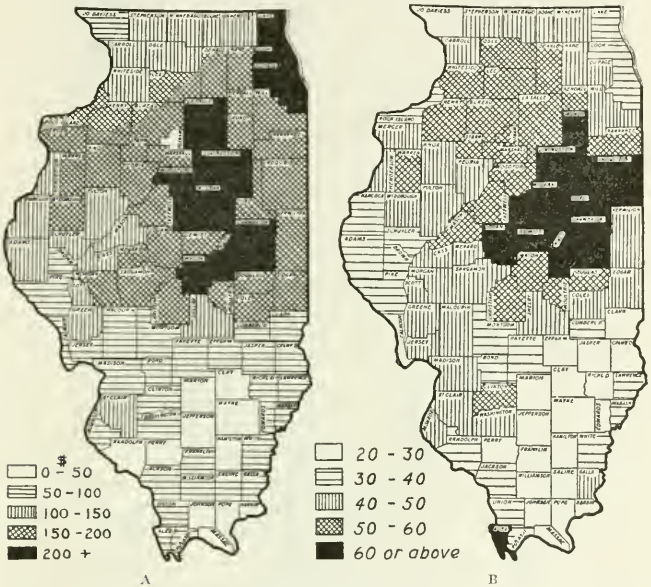

FIG. 39.—Land values (A) and farm tenancy (B) in Illinois in 1925. (Courtesy of Illinois Agricultural Experiment Station.)

under tenancy rises to 60 per cent and over (69.3 per cent in Ford County). It is noticeable that crop land in contrast to pasture and woodland is operated mainly by lease-holders.

Tenancy and specialization in cereal production seem to have gone hand in hand in Illinois and tend to be highly developed where the soil is highly productive. Only in such places, as a rule, can the soil support absentee landlords as well as farmers. In the state as a whole, 42 per cent of the farms were operated by tenants in 1925 (Fig. 39). In the prairie

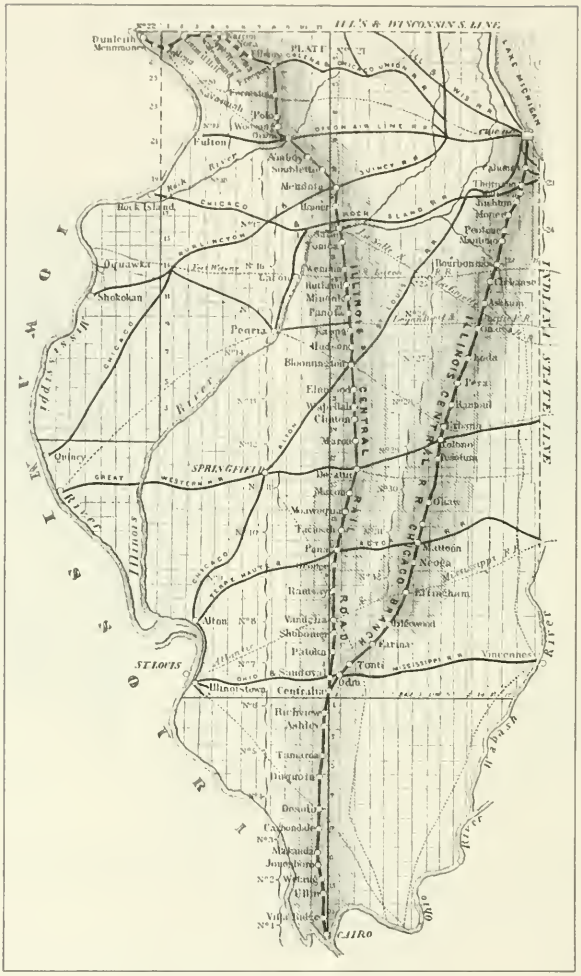

FIG. 40.—Railroads in Illinois in 1855. (From Illinois Central Railroad Company's pamphlet, 1856.)

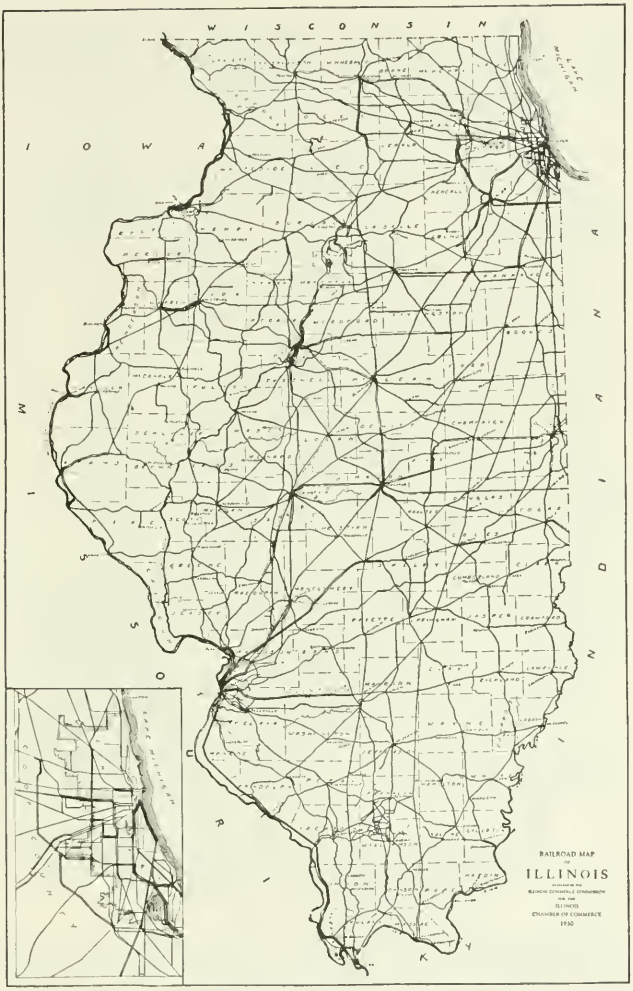

FIG. 41.—Railroads in Illinois in 1930. (Courtesy of Illinois Chamber of Commerce.)

province the figure was 55.7 per cent, an increase from 53.1 per cent in 1910. From the above remarks it appears that the nature of the land tenure of a region depends in part upon geographical conditions—the fertility of the soil and the nature of the topography—which influence the type of land utilization, and ultimately land values and tenancy.

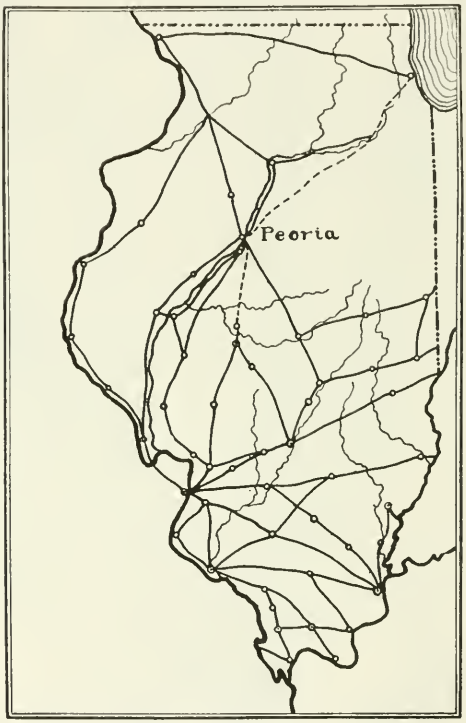

FIG. 42.—Illinois highways in 1832. (Courtesy of Illinois Geological Survey.)

By 1890 the state was well equipped with railroad facilities, and there has been little new mileage of steam railroads built during the last three decades. Attention has been given in recent years to improvements, to double tracking and rebuilding of some of the hastily constructed early

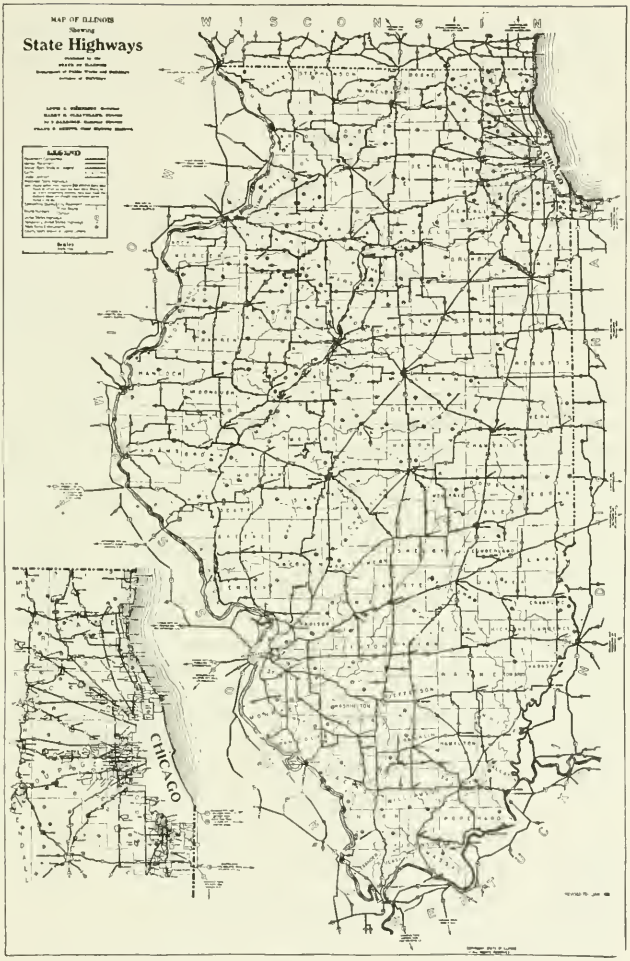

FIG. 43.—Illinois state highways in 1930. (Courtesy of Illinois Chamber of Commerce.)

lines. There were 12,004 miles of steam railroads[36] and 3,416 miles of electric railroads in Illinois in 1927.[37] Texas, which is five times as large, is the only state with more mileage. Between 1889 and 1913 the increase in the total amount of freight carried was fourfold, a rate much greater than the growth of the population during the same period. The value of mineral products grew sixfold, that of the forests fivefold, and that of manufactures over eightfold.[38]

Electric railways are a comparatively new development in the state. The Illinois Traction Company was organized in 1904 out of some 20 companies. Springfield is the center of the system, and the most important lines radiate in all directions across the prairie province. These interurban lines serve an especially useful purpose in an agricultural region such as this, in connecting rural communities with market centers, large quantities of farm products being delivered by them to the cities.

The state has an excellent system of hard-surface highways, as can be seen from Fig. 43. The early highways of 1832, shown in Fig. 42, avoided the sparsely settled prairie province, but today the level topography has made it possible here to construct both railroads and highroads with a minimum amount of excavation and fill, though considerable hauling of road metal is required.

During this period, 1893-1930, the rural population, which was established so late in the prairie province, began to turn away from the rich farm lands towards the urban centers, Chicago serving as the greatest magnet. Human labor was supplanted by mechanical power which enabled the individual farmer to work a larger farm, increase his output, and dispense with many workers. The man-power thus set free gravitated to the cities, where it was absorbed by expanding manufactures.

The increasing urban population created a demand for larger food supplies and for better transportation facilities, which in turn enhanced land values. Agriculture in the prairie province, though conducted on a large scale, became more intensive than previously. Increasing complexity was the keynote of man's adjustment during this period.

Conclusion

Environmental conditions determined the fact that the prairie province should be the last section of Illinois to be settled. Not until the railroad

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[36] *Statistical Abstract of the United States*, 1929, p. 394.

[37] Dunn, S. O., "Transportation Facilities," in *Illinois—Resources, Development, Possibilities.*

[38] Bogart and Mathews, *op. cit.*, vol. 5, p. 122.

was built across the east-central part of the state did the settlers leave the river banks for the prairies, which they then discovered to be of great fertility. The changes in distribution of population for the decades 1840 to 1860—the railroad era—are evidence of what the province owed to railroad development at that time.

After 1860 the whole region rapidly came under cultivation. The level topography, the thick morainic soil, and the accumulation of decomposed prairie vegetation make this excellent crop land, some of the richest in the United States. The climate—particularly the long hot summer, with adequate rainfall—offers optimum conditions for corn, which early became, and still is, the chief money crop. Wheat, oats, and legumes are included in the rotation scheme of the farmer. Finally, the location of the province with regard to Chicago—the great industrial center and land-and-water terminal—assured a ready market and exit for the produce of the region.

These geographical conditions and the human adjustments to them have combined to make the prairie province a homogeneous region, separate and distinct from the mixed-farming region in the southern part of the state, the livestock area of the west, the dairying section of the northwest, and the urban district of the northeast. Extensive methods of cultivation and excellent transportation facilities are characteristic features of the province, making possible the production and marketing of grain on a larger scale than elsewhere in the state.

It is probable that the prairie province will continue to hold a high place among the geographical regions of Illinois. In less than 100 years it has developed from what was considered a wilderness, unfit for settlement, into a region where agriculture is extensively and scientifically carried on, and where industries based upon agricultural products are already well established. With sufficient power available and excellent transportation facilities, it seems likely that the province will use increasing amounts of its own agricultural products and still have a surplus for sale beyond its boundaries. Increasing complexity will result as the interplay of the natural and economic conditions becomes more pronounced. Agriculture will not decrease in importance, but it will not stand alone as it has done heretofore. From the recent population changes and trends in industrial development, it seems likely that Chicago will continue to attract both the produce and the population of the province; but increase in industrial development may be looked for in cities such as Decatur, Danville, and Bloomington, which had an early start along industrial lines, owing to favorable geographic conditions.

BIBLIOGRAPHY

ACKERMAN, W. K., *Historical Sketch of the Illinois Central Railroad.* Fergus Printing Co., Chicago, 1890.

ANDROS, S. O., "Coal Mining in Illinois," *Ill. Min. Inv. Bul. 13* (Ill. Geol. Surv.), 1915.

BAKER, O. E., "Agricultural Regions of North America," *Econ. Geog.*, vol. 2, pp. 459-493, 1926; vol. 3, pp. 447-465, 1927.

BAKER, O. E., "Regional Changes of Farm Animal Production in Relation to Land Utilization," *U. S. Dept. Agr. Preliminary Report,* 1929.

BAKER, O. E., *et al., Atlas of American Agriculture.* U. S. Dept. Agr., Washington, D. C., 1919.

BARROWS, H. H., "Geography of the Middle Illinois Valley," *Ill. Geol. Surv. Bul. 15,* 1910.

BATEMAN, N., and SELBY, P., *History of McLean County.* Munsell Pub. Co., Chicago, 1905.

BAUER, F. C., "Response of Illinois Soils to Systems of Soil Treatment," *Ill. Agr. Exp. Sta. Bul. 362,* 1930.

BECKWITH, H. W., *History of Vermilion County.* H. H. Hill and Co., Chicago, 1879.

BEMENT, A., "Illinois Coal: A Non-technical Account of Its Occurrence, Production, and Preparation," *Ill. Geol. Surv. Bul. 56,* 1929.

BIRKBECK, M., *Letters from Illinois.* Taylor and Hessey, London, 1818.

BIRKBECK, M., *Notes on a Journey in America, Virginia to Illinois.* Taylor and Hessey, London, 1818.

BLANCHARD, R., *History of Illinois—To Accompany an Historical Map of the State.* National School Furnishing Co., Chicago, 1883.

BOGART, E. L., "Farm Ownership in the United States," *Jour. Pol. Econ.,* vol. 16, pp. 201-11, 1908.

BOGART, E. L., *Economic History of the American People.* Longmans, Green, and Co., New York, 1930.

BOGART, E. L., and MATHEWS, J. M., *The Modern Commonwealth.* Illinois Centennial Commission, Springfield, Ill., 1920.

BOGART, E. L., and THOMPSON, C. M., *The Industrial State.* Illinois Centennial Commission, Springfield, Ill., 1920.

BOGGESS, A. C., *The Settlement of Illinois, 1778-1830.* Chicago Historical Society, Chicago, 1908.

BOWMAN, ISAIAH, *Forest Physiography.* John Wiley and Sons, New York, 1911.

BROOKS, E. C., *The Story of Corn and the Western Migration.* Rand-McNally Co., Chicago, 1911.

BROWN, H., *History of Illinois from Its Discovery to the Present Time.* J. Winchester, New York, 1844.

BROWNSON, H. G., *History of the Illinois Central Railroad to 1870.* Univ. of Ill. Studies in Soc. Sci., vol. IV, nos. 3-4, 1915.

BRYAN, P. W., "Natural Environment in Relation to Human Activity in the Corn Belt," *Geography,* vol. XV, no. 83, 1929.

CASE, H. C. M., *et al.,* "Organizing the Corn-Belt Farm for Profitable Production," *Ill. Agr. Exp. Sta. Bul. 329,* 1929.

CHAPMAN, H. H., and MILLER, R. B., "Second Report on a Forest Survey of Illinois: the Economics of Forestry in the State," *Ill. Nat. Hist. Surv. Bul.,* vol. XV, art. 3, 1924.

COFFEEN, H. A., *Vermilion County, Historical, Statistical, and Descriptive.* H. Coffeen, Danville, Ill., 1870.

COLE, A. C., *The Era of the Civil War.* Illinois Centennial Commission, Springfield, Ill., 1920.

CROSSLEY, B. W., and BOWMAN, M. L., *Corn: Growing, Judging, Breeding, Feeding, Marketing.* Privately published, Ames, Iowa, 1908.

DUNN, S. O., "Transportation Facilities," in *Illinois—Resources, Development, Possibilities.* Illinois Chamber of Commerce, Chicago, 1930.

GERHARD, FREDERICK, *Illinois as It Is.* Keen and Lee, Chicago, 1857.

GEHRS, J. H., *Soils and Crops.* Macmillan Co., New York, 1924.

GLEASON, H. A., "Some Unsolved Problems of the Prairies," *Bul. Torr. Bot. Club,* vol. 36, pp. 265-271, 1909.

GLINKA, D. H., *Die Typen der Bodenkunden.* Berlin, 1914.
HABERMEYER, G. C., "Public Groundwater Supplies in Illinois," *Ill. Water Surv. Bul. 21,* 1925.
HALL, R. C., and INGALL, O. D., "Forest Conditions in Illinois," *Ill. Lab. Nat. Hist. Bul.,* vol. IX, art. 4, 1911.
HOPKINS, C. J., "The Fertility of Illinois Soils," *Ill. Agr. Exp. Sta. Bul. 123,* 1908.
HUBBARD, G. D., "A Case of Geographic Influence upon Human Affairs," *Bul. Amer. Geog. Soc.,* vol. 36, pp. 145-57, 1904.
HUNTINGTON, ELLSWORTH, "The Handicap of Poor Land," *Econ. Geog.,* vol. 2, pp. 335-57, 1926.
Illinois Blue Book, issued biennially by the Secretary of State, Springfield, Ill.
Illinois Centennial History, 5 volumes, Illinois Centennial Commission, Springfield, Ill., 1920.
Illinois Central Directory, J. P. Crawford and Co., Chicago, 1860.
Illinois — Resources, Development, Possibilities, Illinois Chamber of Commerce, Chicago, 1930.
Illinois Department of Agriculture, *Crop and Livestock Statistics,* issued annually, Springfield, Ill.
Illinois Department of Agriculture, *Transactions,* issued annually, Springfield, Ill.
Illinois, University of, *Annual Reports of the Agricultural Experiment Station.*
Illinois, University of, *County Soil Reports,* 1911-30.
Illinois, University of, *Graphical Summary of Illinois Agriculture,* (mimeographed), 1928-1929.
(For bulletins and circulars, see author's names.)
KAY, F. H., and WHITE, K. D., "Coal Resources of District VIII (Danville)," *Ill. Min. Inv. Bul. 14* (Ill. Geol. Surv.), 1915.
KAY, G. K., and PEARCE, J. N., "The Origin of Gumbotil," *Jour. Geol.,* vol. 28, pp. 89-125, 1920.
KREY, F., and LAMAR, J. E., "Limestone Resources of Illinois," *Ill. Geol. Surv. Bul. 46,* 1925.
LOTHROP, J. S., *Champaign County Directory,* Chicago, 1871.
LEE, J. F., *Transportation as a Factor in the Development of Northern Illinois,* 1850-60. University of Chicago Press, Chicago, 1917.
LEHMAN, E. W., and HANSON, F. P., "Saving Soil by Use of Mangum Terraces," *Ill. Agr. Exp. Sta. Circ. 290,* 1924.
LEIGHTON, M. M., "Differentiation of the Drift Sheets of Northwestern Illinois," *Jour. Geol.,* vol. 31, pp. 265-81, 1923.
LEIGHTON, M. M., and MACCLINTOCK, P., "Weathered Zones of the Drift Sheets of Illinois," *Jour. Geol.,* vol. 38, pp. 28-53, 1930.
LEIGHTY, C. E., *et al.,* "The Corn Crop," *U. S. Dept. Agr. Yearbook,* 1921.
LEVERETT, F., *The Illinois Glacial Lobe.* U. S. Geol. Surv. Monog. 38, 1899.
MARBUT, C. F., "Soils of the Great Plains," *Ann. Assoc. Amer. Geog.,* vol. 13, pp. 41-51, 1923.
MARKHAM, C. H., "The Development, Strategy, and Traffic of the Illinois Central System," *Econ. Geog.,* vol. 2, pp. 1-19, 1926.
MEYER, B. M., MACGILL, C. E., *et al., History of Transportation in the United States before 1860.* Carnegie Institution of Washington, D. C.
MILLER, M. F., "Ten-Year Average of Erosion Measurements," *Amer. Soil Surv. Assoc., 9th Ann. Rpt.,* pp. 29-34, 1929.
MILLER, R. B., "First Report on a Forestry Survey of Illinois," *Ill. Nat. Hist. Surv. Bul.,* vol. XIV, art. 8, 1923.
MONTGOMERY, E. G., *The Corn Crop.* Macmillan Co., New York, 1916.
MOSIER, J. G., "Climate of Illinois," *Ill. Agr. Exp. Sta. Bul. 208,* 1918.
MOSIER, J. G., *Soils and Crops.* Rand-McNally Co., Chicago, 1919.
MOSIER, J. G., and GUSTAFSON, A. F., "Washing of Soils and Methods of Prevention," *Ill. Agr. Exp. Sta. Bul. 207,* 1918.
NORTON, E. A., *et al.,* "Considerations in Evaluating Illinois Farm Lands," *Ill. Agr. Exp. Sta. Circ. 356,* 1930.
NORTON, L. J., and STEWART, C. L., "Seasonal Features of Illinois Grain Marketing," *Ill. Agr. Exp. Sta. Bul. 324,* 1929.
PARKER, A. A., *Growth of Illinois and Chicago.* W. White, Concord, N. H., 1835.
PARMELLEE, C. W., and SHROYER, C. R., "Further Investigations of Illinois Fire Clays," *Ill. Geol. Surv. Bul. 38D,* 1921.

Pickels, G. W., and Leonard, F. B., "Engineering and Legal Aspects of Land Drainage in Illinois," *Ill. Geol. Surv. Bul. 42,* 1921.
Pooley, *W. V., The Settlement of Illinois from 1830 to 1850.* Univ. of Wisc. Hist. Ser., vol. I, no. 4, 1905.
Rauchenstein, E., "Cost of Producing Field Crops in Three Areas of Illinois, 1913-22." *Ill. Agr. Exp. Sta. Bul. 277,* 1926.
Ridgely, D. C., *Geography of Illinois.* Univ. of Chicago Press, Chicago, 1921.
Sampson, H. C., "An Ecological Survey of the Prairie Vegetation of Illinois," *Ill. Nat. Hist. Surv. Bul.,* vol. XIII, art. 16, 1921.
Sanford, A. H., *The Story of Agriculture in the United States.* D. C. Heath and Co., New York, 1916.
Sauer, C. O., "Geography of the Upper Illinois Valley and History of Its Development," *Ill. Geol. Surv. Bul. 27,* 1916.
Savage, T. E., "Loess in Illinois: Its Origin and Age," *Trans. Ill. Acad. Sci.,* vol. 8, pp. 100-17, 1915.
Smith, C. B., "Rotations in the Corn Belt," *U. S. Dept. Agr. Yearbook,* 1911, pp. 325-36.
Smith, J. W., *Agricultural Meteorology.* Macmillan Co., New York, 1920.
Smith, J. W., "Effect of Weather on the Yield of Corn," *Mo. Weath. Rev.,* vol. 42, pp. 78-87, 1914.
Smith, R. S., and Norton, E. A., "Provisional Soil Map of Illinois," *Ill. Agr. Exp. Sta. Mimeo.,* June, 1929.
Smith, R. S., *et al.,* County Soil Reports, Ill. Agr. Exp. Sta., 1924-30.
Stewart, C. L., *Land Tenure in the United States with Special Reference to Illinois.* Univ. of Ill. Studies in Soc. Sci., vol. 5, no. 3, 1916.
Stewart, C. L., *et al.,* "Market Destinations of Illinois Grain," *Ill. Agr. Exp. Sta. Bul. 318,* 1928.
Telford, C. J., "Third Report on a Forest Survey of Illinois," *Ill. Nat. Hist. Surv. Bul.,* vol. XVI, art. 1, 1926.
Telford, C. J., "Brownfield Woods, a Remnant of the Original Illinois Forest," *Ill. Nat. Hist. Surv. Forest. Circ. 3,* 1926.
Transeau, E. N., "Forest Centers of Eastern America," *Amer. Nat.,* vol. 39, pp. 875-89, 1905.
Transeau, E. N., "Precipitation Types of the Prairies and Forested Regions of the Central States," *Ann. Assoc. Amer. Geog.,* vol. 20, pp. 44-45, 1930.
Trowbridge, A. C., *et al.,* "Geology and Geography of the Galena and Elizabeth Quadrangles," *Ill. Geol. Surv. Bul. 26,* 1916.
United States Bureau of Mines, *Mineral Resources of the United States,* issued annually.
United States Department of Agriculture, *Yearbook of Agriculture.*
United States Weather Bureau, *Climatological Data, Summary for the United States, Sections 64-66.*
Van Hise, C. R., *et al., Conservation of Natural Resources in the United States.* Macmillan Co., New York, 1930.
Von Engeln, O. D., "Effects of Continental Glaciation on Agriculture," *Bul. Amer. Geog. Soc.,* vol. 46, pp. 241-336, 1914.
Voorhees, J. F., "Relation of Temperature and Rainfall to Crop Systems and Production," *Tenn. Agr. Exp. Sta. Bul. 91,* 1911.
Whitbeck, R. H., "Economic Aspects of Glaciation in Wisconsin," *Ann. Assoc. Amer. Geog.,* vol. 3, pp. 62-87, 1913.
Wolfanger, L. A., "Major Soil Groups and Some of Their Geographic Implications," *Amer. Geog. Rev.,* vol. 19, pp. 94-114, 1929.
Wolfanger, L. A., *Major Soil Divisions of the United States.* John Wiley and Sons, New York, 1930.
Young, L. E., "Surface Subsidence in Illinois Resulting from Coal Mining," *Ill. Min. Inv. Bul. 17* (Ill. Geol. Surv.), 1916.

INDEX

Absentee landlords, 111
Acidity, soil, 55, 77
Acreage, field crops, 73-87, 105
Agriculture, 20, 71-88, 99-116
Ague, 99
Alfalfa, 56, 59, 73, 78, 80, 85, 86
Altitude, 29

Bacteria, soil, 79
Beaches, 33
Beef, 19, 82, 87
Belvidere lobe, 22
Bench lands, 54
Biotic factors, 70
Blackberry Creek, 34
Bloomington, 41, 58, 86, 99, 109, 117
Bloomington moraine, 22, 25, 26, 28-32
Blue Ridge, 27
Bluestem sod region, 54, 66, 67
Bluffs, 70
Bottomland soils, 52, 54
Boulders, 25, 27, 32, 34
Brick, 95
Broadlands Ridge, 27
Brownfield Woods, 70
Bureau County, 24, 28, 29, 31, 32, 45, 81, 90
Bureau Creek, 29
Bureau moraine, 31
Butter, 82

Calhoun County, 13
Caparis quarry, 96
Carbon, 77
Carbonates, 49
Cattle, 19, 87, 88
Cellulose, 84
Cereals, *see* Corn, wheat, etc.
Cerro Gordo moraine, 26, 27
Champaign, 28, 40, 41, 45, 70, 109
Champaign County, 24, 26, 40, 49, 77, 81, 82, 98, 99, 101, 102, 103, 105
Champaign morainic system, 27
Charles Mound, 11
Charleston, 25
Cheese, 82
Chernozems, 52
Chicago, 19, 21, 22, 24, 45, 71, 80, 87, 88, 96, 98-100, 107, 112, 116, 117
Chicago and Alton Railroad, 100
Civil War, 101, 102
Clark County, 80, 81
Clay, 25, 49, 54-56, 72, 80, 94, 106
Clay products, 20, 94-96
Climate, 17, 57, 68-70, 72, 84, 116
Clinton, 24
Clover, 56, 59, 77, 78, 80, 86
Coal, 89-98, 106
Coles County, 24, 26, 81
Communication, 98
Connecticut River basin, 26
Contrabands, 101
Cook County, 80
Corn, acreage, 73, 80, 85, 105
  bottomland, 21
  by-products, 84
  cobs, 84
  crop, 80-85, 116
  cultivation, 57, 61
  labor requirements, 76, 105
  moisture requirements, 58
  price, 109
  stalks, 84
  yields, 58, 60
Corn Belt, 19, 21, 81, 105, 111
Crawford County, 81
Crops, 71, 73-78, 79
Cropsey Ridge, 28, 29
Cumberland County, 81, 98
Cultivators, 102

Dairy regions, 19, 81, 116
Danville, 47, 87, 97, 98, 106, 109, 117
Decatur, 24, 26, 58, 86, 87, 99, 109, 117
Deere, John, 101
Degree-hours, 61, 63
De Kalb County, 24, 28, 32, 34
Delavan, 25
Detroit, 96
Devil's Backbone, 34
De Witt County, 24, 49, 99
Divides, 43
Douglas County, 24, 26
Drainage, 26, 40-44, 47, 48, 55, 69, 96, 105
Drifts, glacial, 12, 13, 15, 16, 22, 24, 25, 30, 33, 48, 52, 82
Dunes, 33

Earlville, 32
East St. Louis, 20
Edaphic factors, 70
Edgar County, 24, 26, 81, 89, 99
Eggs, 82
Elevation, 11
Embarrass River, 28, 36, 40, 54
Erie Canal, 97
Erosion, 36, 40
Eskers, 32, 34
Evaporation, 26, 67

Fairmount, 96
Farmer City, 99
Farming, 20, 71-88, 99-116
Feeds, 78
Fertilizers, 71, 77-80, 111
Fodder, 81
Forage, crops, 85
Ford County, 24, 28, 29, 44, 48, 49, 98, 105, 111
Forests, 19, 55, 65, 67, 69, 70, 97, 98, 111

Franklin County, 81
Frosts, 63, 86
Fulton-Peoria coal district, 90
Furfural, 84

Gastropods, 49
Geographic regions, 11, 17, 19, 20, 116
Germination, 61
Gibson City, 45
Gifford Ridge, 30
Glaciation, 12, 13, 16, 22-34, 36, 39, 43, 45, 48, 69
Grand Prairie, 22, 97
Granite, 32
Grasses, 65, 66
Grazing, 67
Great Lakes, 97
Green River basin, 28
Green River lobe, 22
Greenstones, 32
Ground water, 35, 45-47
Gullied areas, 36, 56
Gumbo, 54

Hardin County, 21
Harvesters, 102
Hay, 73, 85, 86
Haydite, 94, 96
Hennepin, 90
Highways, 114-116
Hogs, 19, 75, 86-88
Homer Ridge, 27
Horizons, 49, 50
Hubbard Trace, 98
Humidity, 67, 68
Humus, 65

Ice, *see* Glaciation
Illinoian drift sheet, 13, 16
Illinois Agricultural Experiment Station, 63, 64, 77, 111
Illinois Central Railroad, 45, 99-102, 109
Illinois River, 16, 25, 26, 32, 35, 49, 99, 100, 103, 109
Illinois Traction Company, 116
Illinois-Michigan Canal, 97, 100
Immigration, 97, 98, 101
Indiana, 83, 98
Industries, 89-96, 104, 106, 115
Interurban lines, 116
Iowa, 72, 81
Iroquois County, 24, 33, 48, 54, 80, 98, 103
Iroquois River, 30, 33
Isohyets, 17
Isotherms, 17

Jasper County, 81
Johnson County, 21
Joliet, 80

Kane County, 29, 31, 32
Kaneville, 34
Kankakee, 80
Kankakee County, 98
Kankakee River, 98
Kansan glacial stage, 12, 13
Kaskaskia River, 26, 28, 36, 40, 47
Keewatin, 12
Kickapoo River, 26, 30
Knolls, 32, 33

Labor, 76, 83, 105, 116
Lake Michigan Basin, 40
Land tenure, 114
Land value, 102, 109, 116
Landlords, absentee, 111
Landscape, 71
Lane, John, Jr., 101
Lane, John, Sr., 101
La Salle County, 24, 31, 32, 89
Latitude, 57
Lease-holders, 111
Lee County, 28, 31
Legumes, 76, 77, 79, 85, 116
Limestone, 16, 32, 55, 56, 77, 78, 96
Little Rock Creek, 34
Livestock region, 19, 71, 81, 87, 116
Livingston County, 24, 31, 103
Loam, 54-56, 72, 80
Lobes, glacial, 12, 22
Loess, 13, 15, 32, 48, 52
Logan County, 89

Machinery, 72, 101
Mackinaw River, 26, 29, 33, 44
Macon County, 24, 49, 89, 99
Madison County, 20
Mahomet, 99
Manufacturing, 71, 84, 94, 101, 103, 104, 106, 116
Manure, 78, 80
Marginal ice, 26
Marion County, 81
Markets, 87, 99, 100
Marseilles moraine, 22, 24, 32, 33
Marsh land, 48, 103
Marshall County, 24, 29, 49, 89
Massac County, 21
Mattoon, 25, 45, 87, 109
McLean County, 24, 28, 29, 31, 89, 99, 105
Milk, 82, 88
Milwaukee, 96
Mineral products, 94, 116
Mining, 20, 89, 104, 106, 111
Minonk, 31
Mississippi River, 16, 40, 49
Missouri Experiment Station, 39
Moisture, soil, 57, 64
Monticello, 99
Moraines, 22-33, 70, 116
Moultrie County, 24, 47
Mutton, 82

National Road, 98
Nebraska, 72

Nebraska glacial stage, 12, 13
Newell, F. H., 35
Nitrification, 78
Nitrogen, 56, 76-79, 86

Oats, acreage, 73, 86
  distribution, 84
  food value, 82
  germination, 61
  hulls, 84
  labor requirements, 76
  price, 109
Ohio River, 97, 100
Organic matter in soil, 55, 65, 76
Ottawa, 58, 109
Outwash, 26, 31
Ozark region, 19, 21

Padua, 29, 30
Paris, 58, 87
Park region, 88
Pasture, 56, 111
Patents, 102
Paxton, 42, 45
Peat, 31, 80
Pedalfers, 51
Pedocals, 51
Pennsylvania, 72, 90
Peoria, 25, 86
Peoria County, 28, 29
Peorian interglacial stage, 31
Phosphate, 80
Phosphorus in soil, 56, 77, 78, 80
Physiographic regions, 12, 15, 16
Piatt County, 24, 49, 77, 82, 99, 105
Plains, 28, 69
Plant food, 56, 77
Pleistocene period, 11, 12
Plows, 102
Pontiac, 33, 58
Population, 97-116
Pork, 82, 87
Potatoes, 82
Potassium in soil, 56, 77, 80
Potomac River, 36
Prairie dog, 100
Prairies, area, 19
  definitions, 22
  settlement, 97-103
  vegetation, 67-70
Prairyerths, 52
Precipitation, 17, 35, 57-59, 61, 62, 67-69
Putnam County, 24, 32, 49, 81

Quartzites, 32

Railroads, 99, 100, 103, 105, 114-116
Rainfall, 17, 35, 57-59, 67, 68
Relief, 11, 25, 28
Ridges, 26, 27, 33
River basins, 36
River bluffs, 70
Roads, 114-116
Rock Island Railroad, 100
Rock phosphate, 80
Rock wells, 45
Rotation of crops, 73, 77, 111, 116
Run-off, 35-45
Rye, 61, 82

St. Clair County, 20
St. Joseph, 99
St. Louis and Pacific Railroad, 100
St. Louis region, 20, 80, 96
Saint Peter sandstone, 100
Salt Creek, 30, 99
Salt Fork River, 40
Sand deposits, 31
Sandstone, 96, 109
Sangamon County, 105
Sangamon River, 25, 26, 30, 40, 54, 99, 103
Savannah River, 36
Savoy Ridge, 27
Seasons, 17, 57, 63
Seed selection, 111
Shale, 94, 96
Shelbyville, 25, 29
Shelbyville moraine, 15, 22, 23-26, 28, 81
Short grass plains, 69
Sidney, 99
Silage, 81
Silt, 25, 32, 54-56, 72, 80
Snowfall, 35, 59, 61, 62
Soils, 19, 31, 48-56, 65, 69, 72, 81, 96, 98, 109, 116
Soybeans, 76, 77, 86
Springfield, 116
Stark County, 29
Steamboats, 103
Stony Creek, 30
Streator, 109
Strip-mining, 91, 92
Sugar Creek, 30
Sullivan, 47
Surface water, 35
Swamps, 24, 70, 98
Swine, 19, 75, 86-88
Sycamore, 58
Syncline, 106

Tall grass prairie, 69
Taylorville, 86
Tazewell County, 24, 28, 29, 31, 49, 89
Temperature, 17, 57-64, 67, 68
Tenancy, 111, 112
Terrace soils, 52, 54
Texas, 116
Tile, 55, 95
Tile drainage, 48, 105
Till, 13, 25, 28, 31, 33, 48
Timber, 56, 99, 103
Timber soils, 37, 52-56, 81
Timothy, 85
Topography, 11-34, 43, 44, 52-56
  influence of, 67, 69, 70, 83, 102, 116

Tractors, 72
Trade, 97
Transportation, 97-106, 112-117
Truck farming, 19

United States Steel Corporation, 96
University of Illinois, 45, 58, 64, 77, 111
Upland soils, 39, 53-55, 72
Urban centers, 106, 110, 116
Urban population, 116
Urbana, 99, 109
Urbanization, 107
Utica, 32

Vegetation, 17, 18, 23, 39, 51, 52, 65, 67, 68, 116
Vermilion County, 24, 28, 30-32, 49, 80, 81, 90
Vermilion River, 30, 33, 47, 98, 109

Wabash Railroad, 100
Wabash River, 70, 98-100
Wabash-Vermilion River, 44, 54
Water supplies, 35-47
Waterways, 97
Weathering, 49
Wells, 45-47
Wheat, acreage, 73, 84, 85
  food value, 82
  germination, 61
  labor requirements, 76, 105
  price, 109
Wheat Belt, 105
Wisconsin, 72
Wisconsin County, 81
Wisconsin glacial drift, 12, 15, 22-34, 36, 53-56, 69, 72, 81, 82
Woodford County, 24, 28, 29, 31, 32, 49, 81
Woodland, 70, 111

Yankee Ridge, 27

Zero point of growth, 61
Zones, weathered drift, 13

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